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The Fayrer Gift.
June 1st 1916.

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from his Bro.
J Fayrer

AN

INTRODUCTORY ADDRESS

TO THE

STUDENTS OF THE CALCUTTA MEDICAL COLLEGE,

ON

THE 15TH JUNE 1863,

BY

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Note.—For much of the information contained in this Lecture, I must express my acknowledgments to the following Authors:—Meryon; Christison; Spellman; DeMuller; Buckle; and Pickford.

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INTRODUCTORY ADDRESS

TO THE

STUDENTS OF THE CALCUTTA MEDICAL COLLEGE.

15*th June* 1863.

GENTLEMEN,

IT is a custom, old as the Institution itself, to commence each Academic Year with an introductory address from one of your teachers; and on the present occasion, it has fallen to me to meet you for the purpose of inaugurating this, the 29th Session of the Medical College.

I should have been glad had it devolved on any other among my Colleagues, feeling, as I do, very sensible that I am but indifferently qualified for a duty of so much responsibility.

However, as I have neither the intention, nor option, of setting you the bad example of evading any duty that my position imposes, I shall ask your attention whilst I endeavour, in the short space of time allowed for the purpose, to lay before you, along with some other matters, a summary of what you have to do during your student life, until you become Graduates of Medicine.

I address myself chiefly to the beginners, but I hope to interest you all.

Some of you, no doubt, are here to-day from curiosity; many have been present on former similar occasions; a number, I trust, by your presence, declare your intention of entering seriously upon the study of Medicine, of laying the foundation stone of an

edifice, whose superstructure you hope some day to complete, of making the first step in a path, whose end, though distant, you trust, some day, safely to attain. You have, perhaps, no very definite notion of what you have undertaken ; let me try and give you an idea of that which lies before you.

I have no desire to discourage or dishearten you,—my object indeed should be quite the reverse, but I would state the matter plainly, and ask you to consider it well at the outset. Give it, as I trust you have already done, to some extent, your earnest thought, and then, having made up your minds, begin with a firm determination to persevere, being deterred by no difficulty or obstacle that may beset you on the way.

I have nothing to tell you of that has not been and may not be done by any one, but I warn you candidly that if you are not determined to work and put your shoulder to the wheel, 'twere better that this be your last, as it is, to many of you, your first lecture in Medicine.

The profession of which you are about to commence the preliminary studies, has for its object the preservation of health, the prevention and cure of disease, the alleviation of suffering, the lives, in short, and therefore the best interests of your fellow creatures. You will at once see how great are the responsibilities involved; how much will depend on the mode in which you profit by your opportunities and means of study here. Of these, I need hardly say, I trust you are prepared to avail yourselves by the devotion of your best energies and earnest attention.

In thus urging you, I am not unmindful, how deeply we, as your teachers, are also concerned. It is upon the doctrines and principles you learn in, and carry away from this place, that may depend the welfare and happiness, or misery, not only of yourselves, but of thousands now unknown to any of us. It behoves teacher and student ever to bear this in mind, and that it should incite each to a faithful performance of his respective duties.

The curriculum of your studies has been well considered and carefully laid down by the University of Calcutta, with reference

not only, to the attainment of Degrees in Medicine, but to the best method of making you progressively acquainted in detail with those branches of science that make up the sum of what is required in all well educated Medical men. Not one of these subjects, numerous though they be, is superfluous ; each in its turn is to be well and carefully studied, not only as a simple and abstract branch of science, for its own sake, but with reference to others and in relation, especially, to its practical bearing on Medicine.

To fit you to undertake these studies profitably, to enable you to comprehend their object, scope and value, nay to render you capable of understanding their very nomenclature, it is necessary that you should have received a thoroughly sound preliminary education before you enter on your special training. This also, it has been the design of the University to provide for, by enacting that each of you, before entering College, as a student of Medicine, shall have passed the Entrance Examination in Arts. Now, this is a subject of much importance ; for, it is manifest that if you are not so prepared, your difficulties must be greatly enhanced, not only because you would be incapable of comprehending the language and terminology of science, but that your minds, untrained by previous education, would be incapable of receiving, or retaining the facts with which they should be stored.

In this matter, I think, that notwithstanding the good intentions of those who supervise your education, there is still a shortcoming. For you do come to us at a great disadvantage, in this respect, that, your preliminary education, as a general rule, however sound it may be otherwise, has this great defect, that it is wanting in that elementary instruction in the Classical languages, which is absolutely requisite to a comprehension of even the nomenclature of Medicine, a science, replete, as it is, with terms derived from Latin and Greek.

Now, though no one could be more desirous than I am to see plain English used whenever it possibly may be, yet I am aware that to do so entirely would be impossible, as far as the language of

science is concerned. Nor would it be desirable, for we are often enabled, in one Greek or Latin word, to give expression to an idea that would require for its adequate representation a whole sentence of Anglo Saxon, and therefore I feel that it is a subject of regret that a certain amount of Classical study is not required in the Under-graduate who is to proceed in Medicine.

It is not only in this respect that you are at a disadvantage as compared with students in European Colleges, your previous mode of life, the society in which, as boys, you have mingled, the tone of thought, the example of all about you, have most probably been unfavorable to study, or to the application of your intellectual powers to subjects of the character now to be brought before you.

Sights and objects to the untutored mind, revolting and disgusting; matters to be committed to memory that are at first dull, uninteresting and incomprehensible, or, at the best, but half understood ; the greatest difficulty of all, the inaptitude, at first, for application to study of any kind ; inability to fix the attention on strange matters taught in a foreign language, and of which, beyond the most ordinary expressions, the very meaning of its words is obscure—withal, I might add the difficulties thrown in your way by caste, the objections and prejudices of friends, the troubles that you share with many of your fellow labourers in all countries ;—the "*Res Angusta domi*" ; the difficulty of meeting the expenses of a protracted professional education, and yet, taking all these into consideration, giving each its due weight, and looking at the result,—one cannot but say that, on the whole, it is satisfactory, and that European rational Medicine has taken and secured a firm hold among you.—It is calculated to prove one of the most potent of all Agents in harmonizing differences, in subduing prejudices, and in developing the mutual sympathies and kindly feelings of the races.

I can conceive no sight more gratifying to the philanthropist who looks forward to a more intimate fusion of the British and Indian races, than such an assembly, and for such a purpose, as that I am now addressing.

But to proceed with the matter I have undertaken, I commence at once with the Programme of your student life.

Since the inauguration of the Calcutta University, the right of giving Diplomas in Medicine and Surgery has ceased with this College. It is no longer an examining, though it remains, with you, the only Educational Medical Institution in Bengal. The old and somewhat vague title of Graduate of the Medical College, has given place to that of Licentiate, or Doctor of the University, and the qualifications accorded by these degrees are similar to those of British Universities.

The plan of your education is subject to the control of the Senate of the University, and in some degree it has been varied from that of the former system under the Medical College, when your Examinations were conducted by the College Professors, as such, aided, indeed supervised, by Government Assessors. This is no longer the case, your education being completed in the College, the examinations are conducted by the University, the successful candidates receive their Diplomas, in the form, and, possessing the prestige of, a University Degree.

The Degrees in Medicine granted by this University are those of M. D. and L. M. S. It is to the highest of these, the Doctorate, you, no doubt, will all aspire ; though the lower, the Licentiate, is sufficient to qualify you, legally, to practise your profession.

Let me give you some idea of what you have to do, to enable you to attain to these Academic honors, what they signify, and how they came to have such significance.

The present opportunity is, I think, a good one for making a few remarks on the subject of Universities and Degrees.

You have, no doubt, already made yourselves acquainted with the names of the subjects you are required to study, the number of years that must elapse before you can attain to the much coveted Diploma. But I will go over the Programme with you, and explain in detail as I proceed.

I observe then first, that Candidates for the degree of L. M. S. are required to have been engaged in study for five years at a School of

Medicine recognized by the University; that as a preliminary qualification they must have passed the Entrance Examination. This, as I before said, is an essential qualification and cannot be dispensed with, but might well be enhanced.

This period of five years, with its various subjects of study, is divided into two important sections. The first devoted to the elementary sciences on which Medicine is based; the second to their practical application in Medicine and Surgery themselves.

Now, not only does this division of the whole period of your study exist, but to each year its own special duties and subjects are assigned. Let us take them in the order prescribed, giving a brief outline of the nature and object of each:

The first year is devoted to the following subjects:—

Descriptive and Surgical Anatomy, General Anatomy and Physiology, Dissections, Chemistry, and Botany.

You commence with the very key-stone and alphabet of all your future knowledge. Anatomy, Physiology, and Chemistry, are truly the tripod on which scientific Medicine and Surgery rest. When you have, and not until you have, acquired a thorough and intimate acquaintance with these, can you hope to make any real progress.

In the study of Descriptive and Surgical Anatomy, you learn the structure of the human frame in all its organs, parts, relations, and arrangements, especially with reference to your future dealings with it in a Medical or Surgical point of view. It will be your duty to study it, not only in the Lecture Room, from the demonstrations and oral teachings of your Professor, but by assiduous labour in the Dissecting Room. You will be taught the various tissues and organs, their form, structure, mutual relations, and mechanical uses; you will see in them extraordinary adaptations to ends, marvellous design, the type of all that is perfect in Mechanism. Something, too, of the intimate structure and functions of each organ will be explained to you, as inseparable from a just definition of the parts themselves. You have, in short, to make yourselves fully, exactly, and practically acquainted with the human frame in all its details of structure.

This knowledge can only be attained by diligent combination of study in the Theatre and Dissecting Room. What has been explained and demonstrated by your Professor, you must realize for yourselves, Scalpel in hand, amid the blood and filth of the Dissecting Room. There is no other way of doing it. Anatomy as needed by the Surgeon, can be learned no where else. The most vivid descriptions, the most exact demonstrations of the best dissections, aided by the most accurate drawings, will be all but useless, for they will be forgotten, if not followed up, and impressed on your memory by direct observation and manipulation. This practical knowledge so acquired, you will find invaluable when you come to the performance of Surgical operations on the living body.

As in Descriptive and Surgical Anatomy you were engaged with the statical, so in General Anatomy and Physiology you learn the dynamical part of the study of organic structures. You will have to investigate more minutely and exactly the nature, composition, and functions of the tissues and organs, whose configuration and Anatomical relations have been described to you in the Theatre and Dissecting Room. It is now your business to study their uses and purposes, functions and relations to each other, and to the whole economy—how in the aggregate they constitute the individual, and in what respect each subserves the welfare of the other, and the whole.

You will learn whatever is known of vital action in its normal condition, or state of health; the doctrines of life as far as they are known, and the apparent distinction between organic and inorganic existences. The nature of those vital processes by which existence begins and is continued. The fundamental laws of vital forces and the doctrines of Morphology and development. Something also of the unity of the mental and corporeal states of existence; but here you approach matter of separate enquiry, passing from the regions of matter to those of mind.

The structure of the tissues and organs,—their histology, forms an important part of this branch of your study. Not only

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their minute structure, in the investigation of which the microscope is indispensable, but also the chemical transformation of the ultimate textures, as in respiration and nutrition. You will be taught how the body is maintained in growth and development, how it is protected for a time against decay, how, when injured, it is capable of self repair, how the vital and physical forces are concerned in its creation, growth and decay, how it comes into existence, how it gives origin to other existences like itself, and finally, its own term being accomplished, it sinks into decay, yielding at last to the inexorable laws by which it is dissipated into its primitive elements, to pass into new phases of life, or remain locked in the stillness of inorganic death—

The study of Physiology is described in the prospectus of some Medical Schools, as the " Institutes of Medicine". You will see how aptly it is so designated, how close its relations to rational Medicine. The only true way of " arriving at a theory of disease, is by beginning with a theory of health." " The foundation of all sound pathology must be first taught in an observation, not of the abnormal but of the normal functions of life."

No less essential than the preceding, will be the study of Chemistry, which forms the third item in the Programme of your first year's study. Its purpose is to introduce you to the most important fundamental laws and properties of matter, the chief elementary substances, and the more important combinations into which they enter ; to the laws that govern these combinations, and the various relations that groups of each have to one another. The subject of chemical affinity, combination in definite proportions, the atomic theory, chemical nomenclature and notation, the laws of light, heat, and electricity, will all be explained to you ; and, further, having acquired a sufficient knowledge of Chemistry as applied to matter generally, and the inorganic kingdom of nature, you will become acquainted with combinations in a more complex form, and will be brought in contact with those laws which regulate the Chemistry of living bodies and are inseparably connected with the very springs of life itself. The importance

of this branch of knowledge is paramount ; without it, you are incapable of comprehending the nature of the vital processes upon which the very essence of existence depends. Your knowledge of Medicine, too, must be empirical in the extreme, if you are ignorant of the composition and modes of combination of the agents you employ in the treatment of disease.

Botany is the fourth subject of study of your first year, and though perhaps less directly important at first sight to the Medical student, yet it is one full of interest and importance too. Much of what you have learned in your physiological researches meets you here again. It is life in another shape that you have to study, and you will recognize laws of development, growth, and form similar to those you have already met with in the Animal Kingdom.

The study of Botany, to use the words of Dr. Balfour, involves "the consideration of the anatomical structure, external form, "function, classification, arrangement, and distribution of all "forms of vegetable life over the globe at the present and former "epochs, and the uses to which they are subservient, the examina-"tion of the plant in its earlier stages of development when it "appears a simple cell, and the pursuit of it through all its stages "of growth and development until it attains maturity ; a compre-"hensive view of all the plants which cover the earth, from the "minutest lichen or moss visible by aid of the microscope, to the "most gigantic production of the tropics. It marks the relation "which subsists between all members of the Vegetable World, and "traces the mode in which the most despised weeds contribute "to the growth of the mighty denizen of the forest. It is a "science which demands careful and minute investigation, re-"quires great power of observation and research, and is well "fitted to train the mental power to prompt and vigorous "action."

The study of Botany especially commends itself to the Medical Student, for a large proportion of the agents used in Medicine are vegetable productions ; and to you particularly so, with the

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great advantage you enjoy in one of the finest Botanic Gardens in the world, and the privilege accorded to you of making free use of it.

This completes the work for the first year—a period I earnestly recommend you to devote seriously to study, not so much for the actual amount of knowledge that you may acquire, but that in it, you may impress yourselves with habits of work, you may get well into that way of working, and lay a foundation, of which you will subsequently reap the benefit. Idle away your first Session, and the chances are much in favor of your doing the same with those that follow. You acquire a distaste for the work you have never thoroughly taken to, and the first great difficulty is never surmounted; you have not only got to learn, remember, but you have got to learn how to learn. The first year is the time for it: let me advise you not to allow the chance to escape you.

During your second year, you have to repeat the subjects of the first, and in addition, you have to turn your attention to *Materia Medica* and Practical Pharmacy; your previously acquired knowledge will now be needed, for of these subjects, Botany and Chemistry are essential elements. You will have your attention directed to the Medicinal Agents, whether Vegetable, Animal, or Mineral, that are in use in the treatment of disease, and also the conditions under which they are required, their various modes of action and effects upon the human body, in health as well as in disease. Not only are you to learn the uses, properties, and other qualities of the articles composing the "Materia Medica," but you are required to make yourselves practically acquainted with them in the operations of Pharmacy, which signifies that you are to learn to compound and prepare the drugs with your own hands. This is a very important part of your practical education, and one that will always be of much use to you in after life. It is absolutely essential, indeed, that you should be acquainted with it; you will readily admit, I imagine, that you should know how to prepare the remedies you prescribe.

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This subject of *Materia Medica*, with which is combined that of Therapeutics and Dietetics, is the first practical application of the scientific knowledge you have gained ; you have to do with the action of various agents in the living body. A complete knowledge of their classifications and also of the individual Agents in each group is as essentially necessary as is a perfect comprehension of their Physiological and Therapeutic actions.

With this must be combined a knowledge of the forms in which these *Medicines* may most fitly be prescribed, the substances with which they may be combined, or with which they are incompatible, the doses in which they may be given, and the cautions which peculiar circumstances render necessary.

The subject of diet is one, indeed, of immense importance, and which deserves and demands your best attention. It will, I know, be thoroughly expounded to you.

So much, then, for the second year of your studies. This is not complete, if every spare hour have not been devoted to Practical Anatomy, in the Dissecting Room. I cannot too strongly insist that you should fully avail yourself of the great opportunities you here enjoy. Make yourselves early well acquainted with this most essential part of your education, to leave your leisure for the many other important subjects that have yet to come.

In the third year, you have to repeat your attendance on the lectures on *Materia Medica*, you have still to prosecute your labours in the Dissecting Room; and now, it is to be hoped, that if you have been diligent, you are fast approaching to a tolerably complete acquaintance with the human frame. But you have new matter before you. Your knowledge of Anatomy, Physiology, and Chemistry have to be extended over a wider range. Comparative Anatomy, Zoology, and Practical Chemistry, have to be added to the list of your acquirements. The option is also given you of attending the lectures on Medicine and Surgery.

You have made yourselves acquainted with that of the human frame, you have now to study the structure of the Animal Kingdom

generally. You will, in your researches in human Anatomy, have realized something of the highest type of development, the nearest approach to the perfect idea. Much that was inexplicable then, will now be solved and many phenomena explained that otherwise must have remained unintelligible. Comparative Anatomy teaches you the structure of the Animal World generally, not merely of its individual members.

As Comparative Anatomy tells of the structure of the Animal Kingdom, so Zoology has to do with the arrangement and classification into groups, according to their affinities and structure. It indicates the place of each group or individual in the scale of animal existence, and it gives you an account of what is interesting in their natural history. You are allowed to attend the lectures on Medicine and Surgery in this year, but I think that your time will be so fully occupied with the subjects already named, that I cannot recommend you to attempt anything further at present. Give these your whole time and attention, and you will find that you are sufficiently employed.

Part of your duty in this year is of a practical nature ; you are directed to devote six months to the Medical and Surgical practice of the Hospital, during which time you are to receive clinical instruction, *i. e.* instruction at the bed side on the subject of disease. This is the most important, perhaps, of all your duties. You are now brought into actual contact with disease. It is not to be expected that at first you will make very much progress, but you will learn much that is useful in the treatment of the sick, and in the management and discipline of a Hospital. You will learn in the Medical Wards, how the examination and general treatment of a sick person is conducted, the Physical, Chemical, and other modes of detecting morbid symptoms and conditions. How food, wine, physic, are to be administered, and generally, in fact, how the sick are to be treated ; how cases are recorded and clinical instruction conveyed. If you observe intelligently, and make the most of your time and opportunities, you may, in this year, acquire a fair amount of practical knowledge.

In the Surgical Wards your instruction will be of an analogous character. You will learn the use of bandages, splints, and other mechanical agents; the various operations of dressing and attending to wounds, accidents, and Surgical diseases; the purpose of all Surgical Instruments and appliances. You will acquire the habit of observing, recognizing, and dealing with those emergencies and accidents which the Hospital Surgeon is daily called on to minister to; such as to arrest hœmorrhage, to dress wounds, to support and adjust fractured limbs, to reduce dislocations, and to make such applications as may be necessary. This practical method of studying Surgery is one of the greatest importance, and it is a privilege possessed to a greater extent by you in this School than in any other that I am acquainted with; for what here is part of the duty of every one, is accorded to the European student, after much labor as a reward, or on payment of a considerable sum of money.

But do not suppose that your duties in the Surgical Wards are to be merely of a mechanical, manipulative, or operative nature; you have to observe and study symptoms, just as you do in the Medical Wards, and you will quickly learn that Surgery and Medicine are but sub-divisions of one science, governed by the same principles.

With this year you complete the junior division of your curriculum, and you will be required to pass a University Examination, the successful issue of which, will be your warrant for entering on the senior department. You are now considered to have acquired the elementary knowledge requisite to enable you to proceed in the practical study of Medicine, and accordingly, you will be occupied with practical matters.

In the fourth year you are required to attend lectures on Medicine, Surgery, Midwifery, and Medical Jurisprudence, and again you are called on to prosecute your Anatomical researches in the Dissecting Room. You are to study regional Anatomy, and the performance of Surgical operations on the dead subject. This year also, is to be divided between the Surgical and Medical Wards, with clinical instruction in these subjects.

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In the principles and practice of Medicine you will be taught the symptoms, causes, nature, and treatment of disease as it comes under the Physician's care, that department of Medicine whose province is internal disorder; and a very large and important section it is. You will have explained to you what you have already begun to observe in the Hospital; and you will be fitted to recognize, comprehend, and treat whatever you may there meet with. In Surgery you will be taught the same principles of Pathology applied to another division of disease, the external, occurring in different structures and organs, but yet not separated by any distinct line of definition. You have to do with the manipulative and operative part of Medicine, you have to bring your knowledge of regional Anatomy into action, and to exercise the skill you have acquired in the use of Instruments. But you will be taught that, however important the art of Surgery, the science is not less so; that you can never be a good Surgeon if you are ignorant of Medicine.

In Midwifery or Obstetric Medicine, you have to study the diseases and complications peculiar to the parturient female. You will see that a process, natural and simple in itself, may be attended with most serious complications, accidents and dangers, requiring all the presence of mind and skill you possess, to carry your patient through the time of peril. You will, moreover, be made acquainted with the diseases peculiar to the pregnant state, and to that which follows childbirth, and not of the mother only, but of her offspring. This, too, is a matter to be studied practically; and not until you have aided at the birth of several children, and had your tour of duty in the Midwifery Wards, will your studies in that branch be considered complete.

Medical Jurisprudence or Forensic Medicine, the last of the four new subjects of the fourth year, is also one of the highest importance. You here require all your previous knowledge to aid you in the solution of the questions to be brought before you, often of the deepest interest,—it may be, involving the lives or liberty of your fellow creatures. Upon your knowledge of analytical Chemistry, and

your anatomical and physiological experience, the life of a fellow creature may depend. It cannot be too strongly impressed on your minds, how very responsible your position in such a case would be, how earnestly you should endeavour to fit yourselves to acquit you of it faithfully.

In your fifth and last year of College life, you are again required to repeat the subjects of the previous year, and in addition you have to study Ophthalmic Medicine and Surgery, and Dental Surgery. You will also have the opportunity of learning them practically. To both of these very interesting subjects, I recommend your best attention; your opportunities are peculiarly favorable, for you have out-door Dispensaries with a large attendance of patients who seek relief for these diseases, and who are seen and prescribed for there by the Professors, who have thus such excellent means of affording you practical instruction. Dental Surgery is a recent addition, and not, I believe, a compulsory one; but it is so manifest a benefit to you, that I need hardly urge you to avail yourselves of the opportunity it offers of making yourselves acquainted, practically, with this most necessary, and hitherto neglected branch of Medical Science.

There are yet two subjects to which I must allude, though they have no special place in the College Curriculum, not that they are intentionally omitted, but that they have hardly come to be recognized as of sufficient interest to form subjects for special chairs. Their importance is becoming more and more acknowledged, and I trust the time is not far distant when they will not be left to be dealt with as part of other courses of lectures; but they will, I trust, as they ought, hold a prominent and special place in the education of every student of Medicine. The subjects I allude to are Hygiene, or public health, and General Pathology.

By Hygiene is implied all that "concerns the conditions upon which health depends, and by which it may be preserved and protected in its greatest purity and integrity. It therefore embraces whatever conduces to sustain as well as whatever tends to deteriorate or depress it, to shorten or prolong life, to reduce

or exhalt the general vigor and health of our race under any circumstances." It has to do with the atmosphere we breathe, the food we eat, the fluids we drink, the clothing we wear, the climate we live in, the houses we inhabit, the Hospitals of our sick, their ventilation, capacity, locality—the Barracks of our Troops—the various sources of disease or decay resulting from defects in any or all of these. In short, all that can directly, or indirectly, conduce to the support or deterioration of health, not only of the individual, but of the community. Much, on these matters, you will, doubtless, hear from teachers of other branches, such as Medicine, Surgery, Physiology; but it is impossible that so extensive and important a matter can be exhaustively treated in the partial notices it must of necessity thus receive.

Pathology is not less important. It is to Morbid Anatomy what Physiology is to Normal Anatomy. It is the Physiology and Anatomy of disease. It is, says Mr. Simon, "the science of life under other conditions than those of ideal perfection." I am aware that much of this, also, must be taught by your teachers of Medicine and Surgery; but it is a very extensive subject, and one that well merits a special chair. I trust, that ere long, a separate Department of Pathology may be founded in this and other Medical Schools, where not only will you be taught its principles in the Lecture Room, but its Anatomy, by demonstrations, in the *Post Mortem* Theatre.

Such then is a *résumé* of your occupation for the next five years—no easy task, I can assure you. It will require all your energies fully exerted to carry you through. So much to learn, so many branches of science to become proficient in! Each of them you will perhaps think sufficient in itself to occupy your whole time and attention. You will naturally feel more interested in some subjects than others. It is neither probable nor possible, that you should become equally accomplished in all. I assure you that this is not expected. It is not to be supposed that you are to be as perfect as your teacher may be in any particular branch; but you must have a thorough insight into each,

and with the majority you must be well acquainted. You must distinctly remember, too, the object for which you study them, that it is not merely for themselves, deeply interesting and important as they severally are, but in their relation to the Science of Medicine, *i. e.*, the knowing and treating disease on rational principles.

Remember, that when you approach the bed-side of the sick, it is neither as Chemist, Botanist, Physiologist, Anatomist, nor Specialist of any kind, but as Physicians or Surgeons who have studied the causes and phenomena of disease, its prevention and cure, by aid of the light that these various sciences can throw upon the subject. It is that you may be able to give a reason for what you do, and that you may be prepared to investigate and aid in the progress of Medicine; for without knowledge of this kind, though you may develope details within a narrow circle, you will never extend or enlarge the boundaries of Science.

Such are the objects of your study, and such what you have to do, before the University accept you as qualified for the important duties or fit for the honor of a Licentiate's Degree in Medicine.

Should you, having achieved this honor, desire subsequently to possess the higher grade of Doctor, you will, according to the present rules, have to submit to further examinations in the practical subjects already mentioned, and after a lapse of two years of creditable practice, if found qualified, the highest title that it is in the power of any University to bestow—that of Doctor, will be conferred on you.

And now, as I promised, let me say a few words on the subject of Universities and Degrees.

UNIVERSITIES.

The earliest traces that can be found of Universities are in Italy and France. Considerable obscurity attaches to their foundation, but those of Bologna, Salerno and Paris, are doubtless the first among these Institutions Whichever

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may rightly claim priority, we must attach most interest to Salerno, as there appears to have been the first foundation of a Medical School, in the 7th century. Bologna, long famous as a School of Jurisprudence, pretends to trace its origin to the time of the Emperor Theodosius II., in the year 433.

Paris, no less famous as a School of Theology, refers its origin to Charles the Great as its founder, in the 8th century. But Antiquarians refuse to recognize in these two Institutions any State authority as Universities before the 12th century, as up to that date they were mere *Scholà* or Schools; such, indeed, would seem to have been the origin of Universities generally—an assemblage of pupils and teachers with self-framed Laws and Constitution. Such they were found with, and ultimately confirmed in, by order of the Sovereign.

Salerno, as an University, is traced to the 10th century; a little later, the Schools of Bologna and Paris also received, by Royal edict, the status of Universities.*

Thus, probably, the three may be assigned to about the same period of History, all possessing, sooner or later, Schools of Medicine. That of Salerno is to us most interesting, as being not only the first University School of Medicine in Europe, but the first where Medical Degrees were conferred. Before the 10th century, there are traces of a School of Medicine, also, in the neighbouring Monastery of Monte Casino; and tradition points to the development of the Salernitan School by Constantine, a Carthagenian pilgrim who, returning from Asia, enriched with its Medical learning, and being in danger of his life from his own countrymen, as a Magician, fled to Italy, took refuge in the School of Salerno, and becoming a great master, attracted numerous Students from all parts of Europe and Asia; for it is said that Greeks, Jews, Saracens, and Franks flocked there, and the fame of the Salernitan School rose so high that its doctrines became universally known and promulgated.

In 1140, a decree of Ruggiero, the King of Sicily and Naples who had himself studied Medicine at Salerno, ordained that its

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own statutes should have the force of law. These statutes being those established by the Scholars and Teachers themselves, thus became law by Royal edict.

In the early period of its existence, Degrees had begun to be conferred. The teachers were called *Magistri* or Masters, the pupils Scholares. It would appear that the pupils who had completed their studies were called Magistri also; and subsequently, to distinguish the practitioners from those who remained in the School as teachers, the latter were designated "Magistri legentes."

In 1224, the Emperor Frederick II., having consolidated the Schools of Salerno and Naples into a new University, issued orders that no one should practice Medicine without testimonials of fitness from both the Magistri of the Schools, and the Government—a license to practise in fact, and permission to assume, with that right, the title of Magistri or Masters. All were prohibited from practising who were not so qualified. Here we have the origin of a Degree as a privileged title by mutual authority of the Government and University. It is to be remarked, that the early progress of the Universities of Bologna and Paris correspond with that of Salerno, and no doubt can exist that they exercised great influence on the Education, Civilization, and Liberties of Europe.

It appears that Frederick II. had much regard for the profession of Medicine, as he it was who caused the Works of Aristotle to be translated and used in the Schools with those of Hippocrates and Galen, which were also studied at Salerno. He forbid any one ignorant of Anatomy and Logic to practise Medicine. The educational course then comprising Medicine, five years, and Logic, three years. He also directed that the highest Degree in Medicine should be given only to those who had studied at Salerno. Other Universities, such as Montpelier, Vienna, Padua, soon rose into existence.

The privileges accorded by the Sovereign to the Universities, gave to the Professors a political importance, which served to consolidate these Institutions; on the other hand, these very privileges gave origin to a spirit of independence and license among students, which frequently caused serious disturbances.

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The origin of many of the minor Universities is due to these dissentions; for example, in Paris, in the reign of Louis III., a dispute between the Magistrates and University Authorities resulted in the Professors and Students leaving Paris: not a few other cities in France profiting by this loss to the Capital. In the close of the 15th century, a similar dispersion occurred in the University of Leipzic, on the subject of a disease which had but recently become notorious, not only from its ravages among the Troops of Charles VIII. of France, and Ferdinand II. of Spain, during the siege of Naples, but throughout the entire population of the South of Europe. The disputes concerning the treatment of this malady ran so high, that Professors and Students deserted the University, and spreading abroad and settling in other cities, became the founders of other Universities, such as those of Wittenberg and Frankfort-on-the-Oder. Many of the more modern Universities were founded by Royal Charter confirmed by Papal Bull. This concurrence of the Church the Popes were not slow to establish, recognizing the influence such important bodies must have on the progress of civilization. A certain reciprocity of rights arose out of this Papal concurrence which extended over the Universities of all Christendom, and by which the Students and Graduates of all Universities were admitted to each other on easy terms. Traces of this still remain; a British Graduate, for example, on presenting his Diploma, is admitted freely to the University Lectures in Paris.

But time would fail me to trace the history of all the European Universities. Of the three primary ones, Bologna and Paris still remain. Salerno has become a tradition.

Let us glance at the British Universities. These, like those of Germany and Holland, are modelled after that of Paris, whilst those of Spain and Italy are after Bologna. The English Universities are Oxford, Cambridge, Durham, and London; the Irish are Dublin, the Queen's University, and the Catholic University. In Scotland, Glasgow, St. Andrew's, Aberdeen, Edinburgh. These, with the exception of London, Durham, and the Catholic

and Queen's Universities in Ireland, are of ancient or mediæval dates, taking their rise with, and like those, on the Continent.

In England, Oxford, and Cambridge, (the Universities *par excellence*), date their foundations from the 13th century, Oxford having been recognized as a University as early as 1201, by King John ; Cambridge, by Henry III., in 1231 ; though in each case, as with the three older Continental Universities, they had long before existed as Schools, Oxford dating from 886, Cambridge from 1110. Like their Continental types, they arose in the midst of ignorance, a few learned men collecting around them—those zealous for the acquisition of knowledge, and so acquired consuetudinary rights and privileges, which the Monarchs who gave them their charters as Universities were glad to adopt and consolidate.

In Scotland, the oldest University is that of St. Andrew's, which was founded in 1411 or 1413 by a Bishop, and confirmed by a Bull from Pope Benedict XIII., its privileges being ratified by King James I. in 1423.

Glasgow was founded by King James II. in 1450, and confirmed by Pope Nicholas V. Aberdeen was founded in 1494 by a Bull from Pope Alexander VI. on the request of James IV. Edinburgh, the junior of the Scottish Universities, was founded by King James VI. in 1582 : he gave it his name and promised to endow it. The name—the College of the Edinburgh University still retains, as the College of King James VI. The endowment was however forgotten. With this University the Pope had nothing to do ; its foundation is due only to the King.

The University of Dublin was founded in the year 1593, and it is modelled, I believe, on that of Oxford. Queen's College, Ireland, was founded in 1850. The Catholic University is also of quite recent date.

The Universities of *Durham* and *London* are also of modern date. The former was founded in 1837, the latter in 1836, and it is that which most interests us here, as it is the model on which the Indian Universities are founded. The great difference

between it and others being that it is purely an examining body. That although it lays down a plan of education in each Faculty, it does not itself profess to teach. In lieu of teaching, it selects, and, as in the case of the Indian Universities, affiliates such Schools and Colleges as it deems capable of affording the necessary instructions, and thus, after supervising their education, accepts Candidates and confers Degrees on them, when found duly qualified. In this respect, these Universities, London and Indian, differ widely from others, which require that the education of the Candidate for a Degree shall have been conducted, if not within their own walls, at least within those of some other University. Now *here* as in London, the only condition is, that the training obtained in such affiliated School shall have been good, and the knowledge sound. It seeks not to insist on the locality in which the student shall have received his education.—Its Schools and Colleges extend from the Punjab to Ceylon. Its functions are simply those of an examining body, controlling and directing the plan of education.

You will, I trust, have gathered from what I have said, something of what is meant by a University; that it is a Corporation consisting of a Chancellor or Head, a Vice-Chancellor who is the Executive Head, with Senate and Syndicate or executive body of the Senate, and its Fellows or Members, who are divided into Faculties. These are Theology, Law, Medicine, Music, Science, Arts, and in the Indian Universities, Civil Engineering.

The British Universities have generally only had the Faculties of Divinity, Law, and Physic. Music has comparatively, lately, been elevated to the dignity of a Faculty, and, but very recently, the University of London has determined to give Degrees in Science, having also, I conclude, instituted a corresponding Faculty.

Civil Engineering is the last created Faculty, it having been made so in this University, which dates its foundation, like its Sisters of Madras and Bombay, in 1857.—Divinity, Law, Physic, in that order of precedence, I may add, are described as the superior Faculties.

So much then for the Universities, their position as Educational Institutions and their right of conferring Degrees.

The next question is, what is meant by a Degree? and what are the advantages, honors, and privileges it confers? These, like the laws and privileges of the Universities themselves, originally consuetudinary, have become legal rights.

As I mentioned to you with reference to the earliest Universities, the Emperor Frederick found that the *custom* was to give the title of *Magister* to a qualified Physician. He ordered that it should be done so by law, and since that time such has been the nature of the University Degree.

As there are various grades or steps in the progress of learning, so there should be various distinctions in the dignity of those who have studied; and the grades and Degrees have consequently been various. In some Universities, as many as four,—Bachelor, Licentiate, Master, Doctor; and these titles are still retained, the Bachelor being the lowest, the Doctor the highest, in any Faculty in which it is conferred.

I have already told you how Graduates came to be called Magister (Master), let me now tell you something about the Doctors, Bachelors, and Licentiates.

Degrees were first regularly methodized at Bologna and Paris. The first Degree was that of Bachelor,* next the Licentiate, third the Master, fourth and highest the Doctor. But it was not essential that every Candidate should pass through all the lower, before he could reach the higher, he might, if qualified, attain the highest at once, "per saltum."

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* As to the Etymology of Bachelor. The Baccalaureate or Bachelor's Degree, said to have been derived from the Knight Bachelor (Bas Chevalier), which was the lowest Degree of Knighthood. The term was applied to the lowest Degree in learning, and was probably first in use in France.

Baccalaurei are also said to have been so called from Baculum, a Baton (a stick), given to students as a mark of their having attained a certain Degree in learning.

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It is supposed that Degrees had their primary root in the three honors successively conferred on the Students of the Academy of Athens. But Degrees, as now known, were first devised by Gratiano, a famous Law Professor of Bologna, in the 12th century, or by Pope Eugene, with Gratiano's aid, in the year 1150; and it is said that they were transferred to Paris in 1152, by Peter Lombard. At that time, however, the title Magister and Doctor were not new. 80 years later, the Bachelor, Licentiate, and Magister, are alluded to in a Bull of Gregory IX., addressed in 1231 to the Magistri and Scholares of Paris, but they are alluded to as existing Degrees, and not as new inventions.

There were thus four titles, but only three real steps in graduation; first, the Bachelor; next the Licentiate, (not only as a License to practise in Theology, Law, or Medicine, but actually as a step in graduation); third, the Magister; and fourth, the Doctor, which were then almost synonymous. When Magister ceased to denote a Teacher only, and was applied to simple Graduates, the Professors became Doctores or Teachers; but subsequently, as in the instance of Masters, many Doctors did not teach, although graduated to do so, the title, as that of a simple, though the highest, graduate remained.

In Paris, the Professors were then called, for the sake of distinction, "Doctores Regentes," as formerly the Magistri who taught were called "*Magistri legentes.*" The title of Magister and Regent were long preserved in the Scottish Universities. Magister is still the highest Degree in Arts. The Doctorate in that Faculty has never been given, except in the German Universities, where it is given, as "Doctor Philosophiæ," not Artium. In Medicine, at the present day, the Degrees usually given are those of Bachelor and Doctor, and in one or two Universities there is also the Licentiate; but it has not the same significance exactly, as the License of the older Universities, being rather a License to practise given to Bachelors or others, in some cases to men who have not graduated at all, (and not as a separate Degree.)—It is only of quite recent date, in fact within the last two or three

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years that in the Scottish Universities, the minor Degree of Bachelor of Medicine has been made use of, and now it is given previous to the Doctorate, as in the English Universities, where the Degree of Doctor is not conferred until some time after the Bachelor's Degree has been attained.

Here, in this University, the Licentiate has been made to substitute the M.B. ; but it is now under consideration, whether it may not be desirable to adopt the Degree in use elsewhere. The title of Magister is again brought into use as a Medical Degree in our Universities, and students can now graduate as Masters in Surgery, after becoming Bachelors of Medicine. As the Faculty of Medicine includes Surgery, as all other departments of Medicine, it is hard to see where the necessity of this new or resuscitated Degree existed ; as there can be no doubt that by ancient right, the Graduate of Medicine was fully entitled to practise every branch of his profession. It appears to have arisen out of the jealousy of the Surgical Corporations, which had rendered a separate and special qualification in Surgery necessary for many public Medical appointments.*

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* In Germany, early in the 16th century, the position of University Doctors of Divinity, Law, or Physic, was as follows:—

"The Diplomas of all three conferred certain privileges. If circumstances ever brought the holders of these Diplomas before a Judge, they might remain seated whilst sentence was being pronounced. Their wives were authorized to dress as noble ladies did. The old German Doctor might wear a sword, a confession of Nobility, though not nobly born, which was never made in France or Italy. He was, moreover, exempt from certain taxes ; he was never subjected to pay tribute of customs, or duty of excise. He was also free from arrest ; nor could he be summoned against his will, as a witness ; but when he chose to make a deposition, his oath, or his word, were held to be twice as potential as that of an ordinary man."—*Meryon's Hist., Medicine.*

Such was the position and status of the Doctor Graduate in the 16th century in Germany. In England, at the present day, it is also high, being the greatest honor a University can bestow, and carrying with it high social distinction. Its position in India remains yet undetermined, but we may hope that the evidences of learning will receive no less favourable a recognition here than they do in Europe.

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But this sketch of the history and nature of Universities as Medical Schools would be very incomplete, were I not to say something of the other Medical Corporations which have exercised so powerful an influence on Medical Education in the United Kingdom, and through which, differing from most other countries, it has been brought to pass, that a large proportion of Medical men are not Members of any University at all.

The Medical Corporations to which I refer, are the Colleges of Physicians and Surgeons, and the Apothecaries' Societies, all giving Diplomas or Licenses quite independent of the Universities, though gladly conferring them on Graduates who may desire to conform to their regulations.

With reference to the College of Physicians, it is to be remarked that it has, as a general rule, admitted, especially to the higher grade of Fellowship, only Graduates.

Until the passing of the Medical Act of 1859, each Corporation had its own peculiar privileges, and each section of the United Kingdom had its exclusive rights as to Medical practice. The Universities though granting the highest titles, were regarded rather as conferring Academic distinction than professional right; and in many public Offices it was requisite that the candidate should not only be a Graduate, but that he should also be licensed by one or other of the Corporations.

This is no longer absolutely the case. The professional rights and privileges of all who have been duly registered as qualified, except India, where the Medical Act has not yet been made operative, are recognized throughout the whole of Her Majesty's dominions.

The old distinctions between Physician, Surgeon, and Apothecary will yet, no doubt, be maintained to a certain extent, but they will depend more on individual qualification and attainments than professional title.

Degrees in Academic rank will also, no doubt, maintain *their* position, but it is to be hoped that the dissensions and troubles that have agitated, divided, and obstructed the progress of our profession, and in some degree degraded it to the position of a

trade, will cease, and that the general tendency will be towards progress, and the promotion of a higher standard of Medical ability, as well as of professional ethics.

Here in India, the sole qualification is the University Degree; you obtain with it the right to practise any branch of your profession, you attain also a recognized position in the scientific world, and a status of high respectability in a social point of view. Let me urge you to do your best as students, worthily to attain to this Academic rank, and having attained, to maintain it in all its integrity, and do honor to the position in the social scale in which it places you.

Time does not permit that I should detain you longer, and I will conclude what I have to say in a few words.

Let me again urge you to consider the importance of what you have undertaken. Approach it with a firm determination to overcome all difficulties, and whilst ever keeping your eye steadily on the end, endeavour thoroughly to grasp and master each subject successively in detail; you will thus, with perseverance and industry accomplish much, and acquire a sure and accurate knowledge of the elements of your profession. Take advantage of the great opportunities you enjoy in this School of obtaining practical knowledge of your work. Labour hard whilst you are young, that you may implant in your natures habits of work, and acquire, in so doing, a stock of facts and information, the value of which, though at the time you may not entirely appreciate, yet will always serve you in after life, when your matured intellect and experience may have taught you how to generalize and apply them in practice. Above all, do not put off working until the last: you may cram yourselves for an examination by so doing, but your knowledge will be worthless, for it will have no hold, and will desert you—good fortune if it do not fail you, when in your examinations you are submitted to the final test.

Let me entreat of you to view the responsibilities of your position, even as students in Hospital, in a proper light. In your daily routine of duty in the Wards, you will have it constantly

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in your power to prove how thoroughly you appreciate and act up to the great object of the calling you have chosen—to relieve suffering, even if you cannot cure disease. Do not look upon the patients as mere objects of scientific or professional interest, but prove to them that sympathy, kindness, and mindfulness of their wants are quite compatible with, and even prior to, the scientific interest with which you regard them as patients, and that in both lights you study their welfare and watch them with the greatest care.

Let me advise you to be very punctual, careful, and diligent in your attendance in the Lecture Room and in your Hospital duties. Try and be so, not because you have a roll-call to respond to, and the penalty of a forfeit certificate to pay, if you are absent beyond a certain number of times, but because you like your work, you take an interest in your studies, and you see the necessity of order, punctuality, and regularity in this, as in all other concerns of life.

Be as inquisitive and persevering in your investigations as you can, remember that you come to learn, and that we are here to teach. You are not expected to know at first, and you need never be ashamed of asking for information when you are ignorant. Do not, therefore, be deterred either by bashfulness, vanity, or false modesty, from seeking information in each other's presence, from fear of shewing ignorance in your laudable efforts to gain knowledge.

We have all much to learn, *our* profession is one, indeed, in which we must, if we wish to be doing good, ever be diligent and humble students.

Do much with your own hands. There is no disgrace in performing many offices for the sick, with skilled hands guided by scientific heads, which in other situations of life you would naturally turn from as degrading and menial in their nature. All that you will be asked or required to do as Dressers or Clinical Clerks, much as some of it may at first astonish you, has been done by the great men whose names you revere, whose books you study, and of whose fame you are proud, as I trust some of

you will be able to emulate. Rest assured, that they never would have been what they were, or are, had they shrunk from such duties and operations, as it must fall to the lot of every Dresser and Clinical Clerk to perform, and which students in European Hospitals are eager to compete for, and pay for the privilege of doing.

Now I make these observations to you in a friendly spirit, and not as finding fault, but because I think I have seen occasional shrinking from duties which were from a mistaken sense of dignity or self respect, I suppose, deemed to be derogatory. Let me assure you that such a view is a mistaken one, that true dignity lies in doing your duty without reference to the personal inconvenience it may temporarily cause you, and without shrinking from anything however disagreeable, at a first glance it may appear, by which you can gain knowledge and contribute to the welfare of the sick. Rest assured also that you will never be called on to do anything that your Teachers themselves have not done.

The very nature of your avocations, your constant familiarity with disease, suffering, decay, and death in all its forms and stages, though they may render you apparently less susceptible to the deeper emotions and more solemn reflections with which such experiences would affect casual observers, yet cannot fail to impress you with a true sympathy and appreciation of the sufferings to which human nature is liable, showing to you at the same time how transient and uncertain all mere worldly considerations are, and ever must be. Nor can they fail, whilst exciting your sympathies and calling forth all your better feelings, to impress you deeply with a sense of the magnitude of your own responsibility, and of the solemn nature of the obligations imposed. The moral lessons to be derived from such reflections, it may not perhaps be considered within my province to dilate on here, but still I would not pass them by in silence, nor fail to urge you whilst pondering them deeply, to lay to heart the important truths they teach. Remember, that whilst justly you may feel pride in the power your knowledge confers, that you must exercise it with humility, bearing in mind how fallible after all the best may prove, and

that you are, even when most successful, but the humble instruments of a higher power in whose hands you are, and on whose guidance your dependence must rest.*

In conclusion, let me in the words of Dr. J. Brown, remind you—"That to a thinking man the profession of Medicine must ever be a serious thing, to feel that the lives of his fellow mortals are in his charge, and that he has to stand as it were between them and Death, Eternity, and the Judgment Seat, and to fight hand to hand with Death;" or as that great Physician and good man, Dr. Sydenham, in reference to this, says,—"What it would be well that all Doctors, young and old, would consider, it becomes every man who proposes to give himself to the care of others, seriously to consider the following things:—

"That he must one day give an account to the Superior Judge of all the lives intrusted to his care.

"That all his skill, knowledge, and energy, as they have been given him by God, so they should be exercised for His glory and the good of mankind, and not for mere gain and ambition.

"That the Doctor being himself a mortal man, should be diligent and tender in relieving his suffering patients, inasmuch as he himself may one day be a like sufferer."

I will detain you no longer than to say that we welcome you cordially to the College, that we are prepared to do all in our power to guide and instruct you rightly in the work before you, and that we hope you will in the same spirit as seriously endeavour to assist us in promoting the common object,—the welfare of the sick, the instruction of the student, and the advancement of our Profession.

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* Author of *Horæ Subsecivæ*.

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NOTES OF A SHORT ADDRESS
TO THE CANDIDATES AT THE OPENING OF THE ARMY MEDICAL SCHOOL AT NETLEY, APRIL 1st, 1875.

By J. FAYRER, M.D., C.S.I.,
President of the Indian Medical Board; Member of the Senate.

Gentlemen,—By permission of Dr. Fraser and the Senate, I propose to make a few remarks on this occasion of the commencement of another session of the Army Medical School. My reason for doing so is, that I think a few words from one who has been long engaged in the work you are commencing may not be out of place. They will be the result of some experience, and you may accept them as a token of the interest I take in your future career.

No position in which I have been placed has afforded me more satisfaction than that I now occupy as a member of the Senate of this School; for it places me in relation with the rising generation of medical officers, and enables me to feel that I may still in some degree further that which has always deeply interested me—medical education.

It is more than a quarter of a century, though it seems but as yesterday, since I was, as you now are, commencing my career as a medical officer; but how great are your advantages, compared with those of the date to which I look back! How much has been done to promote your interests and improve the means of fitting you for your work! Since the Crimean war, great changes have taken place in the constitution of the medical services, and in the duties and responsibilities of the medical officers. The sciences of military hygiene and medicine have made rapid progress. The medical officer is no longer regarded merely as the physician or surgeon to treat disease or wound; he is the guardian of the health of armies and fleets. In some cases, and especially in India, he holds the same position in regard to the civil population. It is a fact, that officers in the Indian Medical Service, as sanitary commissioners, are the guardians of the health of two hundred millions of people.

Your duties will be of a varied character, and you must be well prepared to discharge them efficiently. Prevention of disease and preservation of health are very essential; but they must not occupy your attention to the exclusion of the study of disease itself, which you must be prepared to treat in every form, and as it occurs in epidemic and endemic visitations. You must be general practitioners in the widest sense of the term, equally prepared to perform a surgical operation, treat disease, lay down the sanitary conditions for the proper construction of a barrack or hospital, analyse a doubtful potable water, detect an obscure poison, or deal with an impending or present visitation of cholera or other epidemic disease. Where you are going, there will be no room for specialisation. Admirable as the specialist may be in great cities, he would be of little use in a field-hospital or ironclad during an action, or in a cholera or fever camp in India or the tropics.

In some services, the medical officers have substantive military rank. The Medical Director-General of the United States army is a general. The reports of his department contain papers by majors and captains, who are the surgeons and assistant-surgeons of regiments. Such is not the case with us; and you must bear in mind that, though your position is as good as that of other officers, your relative rank gives you no title to assume the duties or offices of the combatant branch. I need hardly hint at the bad taste of assuming anything to which you are not entitled, especially that to which your own position as members of a learned profession should make you indifferent. But still you are soldiers; and it may happen, as it has done before, to devolve on you, in emergencies, to act as such. You have many brilliant examples of the medical taking the place of the combatant officer. Should it fall to your lot, be ready to show that you are as ready for this as for any other duty.

Let me advise you not to forget that you are medical at the same time as you are military men. Let there be a due combination of each element. Keep to your own distinct sphere of duty, and you will exercise great influence for good. Overstep it, and you will not only

be in a false position, but your efforts for good will be negatived, and your counsels useless. So much of the influence for good in the position of the medical officer depends on his personal character, that you should endeavour to let the standard of that be pitched as high as possible.

Whatever may be said or thought of the position of the medical officers collectively, no one can deny that individually they always receive the consideration and respect that is due to their own individual and personal merits. You have abundant examples—living, I am glad to say—to imitate; and I might remind you of one recently removed from among us ripe in age and distinction, who always and to the last took deep interest in this school and in his younger brethren, who has left us the history of a life and character, which all young naval and military surgeons may study with advantage.

Having completed your work at Netley, you will be ready to enter on your duties, and you will probably think that you are entitled to rest after your labours, and have leisure to digest and assimilate all that you have taken in here. But short interval will intervene before you are in harness, and begin the business of life in earnest. You will realise the value of the training you have received. You must act for yourselves, add to your stock of knowledge and that which may be of use to your successors in this school, when, perchance, one of you may occupy one of its professorial chairs, or endeavour, as I do, to encourage your younger brethren in starting on their journey in life.

The field before you is large. Far from being exhausted, it is in many places hardly touched. Great problems of hygiene and medicine still await solution. Large questions concerning disease; the laws regulating the rise and spread of cholera and other epidemics, their pathology, etiology, and therapeutics; the nature and action of that which in our ignorance we call malaria; the subject of fever in all forms; and many kindred subjects—will engage your attention, and give you ample ground for exploration and discovery. Or, apart from medicine and hygiene, we may turn to the whole range of natural science. The zoology, botany, geology, mineralogy, meteorology, climatology, ethnology, of many countries, and especially of India, offer rich mines, in which are veins of wealth yet unexplored and unrevealed.

You must feel a longing to enter on a career that offers so many paths to instruction. Think, too, of the examples in whose footsteps you may follow, and of what has been done by such men—all military or naval surgeons—as Guthrie, Ballingall, Richardson, Falconer, Annesley, Twining, Thompson, Martin, Hooker, Huxley, Flower, Parkes, Maclean, Longmore, Goodeve, Chevers, Murchison, and many more; and shall they not be followed by some whose names will be written in the annals of this school? I must not dwell longer, much as I should like to do so, on this subject, for I have a few words to say about the services you are to join, and especially of the Indian; for though I have served in them all, I am best qualified to speak of that in which the greater part of my life has been passed.

The covenanted Indian medical service comprised, on January 1st, 1875, 675 members of all ranks; of these, 3 were surgeons-general, 22 deputy surgeons-general, 357 surgeons-major, and 293 surgeons. The designation of assistant-surgeon, as you are aware, has been discontinued. This was a title in no case, perhaps, very appropriate, but least of all so in India, where most commissioned medical officers held independent charges from the beginning. There are three divisions, those of Bengal, Madras, and Bombay, each with its own list, and not concerned with the others. To one or other of these, according to circumstances, already doubtless known to you, those destined for India will belong; and to any of the varied appointments offered by them each of you may aspire. I wish, however, to remind you, that the Indian medical service is not purely military, but general, and that it is not the public medical service only, but *the* medical profession in India; for on you will devolve all important professional duties, including medical education, in the country.

Two years must be passed in military duty before you can obtain promotion; but, after that is completed, the work is often of a different character, and quite distinct from the army. There is also another condition, that, before you can permanently hold any appointment, civil or military, you must pass an examination in the language of the Presidency to which

you belong. This used formerly to be merely colloquial; it now includes both reading and writing the language in the native character, and I strongly recommend you to set yourselves to do this immediately after reaching India. It is important that you should commence it early, for if put off it becomes irksome, as increasing work leaves you less time and inclination to devote to it. Though the lower standard, as it is called, is all that is absolutely required, you will do well to aim at the higher; and there are others still more advanced, for which a successful examination is rewarded by a considerable sum of money—sufficient, at least, to defray the expenses of tuition. The value of a sound knowledge of the language is great; it is seldom acquired if not begun early; it is essential in your communication with the natives, and is a condition of holding many appointments. No one, I am sure, has ever had cause, even when it was not compulsory, to regret the time or labour bestowed on it.

The grades in the Indian are like those in the British medical service, though you have the exceptional advantage of promotion to surgeon-major after the lapse of twelve years, if you have passed a professional examination, which is, in future, to be enforced, though it has not been so up to the present time. This, also, you should do as soon as possible, whilst the habits of study and passing examinations, in which you have been pretty well exercised, are fresh upon you. Depend on it, these things do not become easier from delay, and you will feel more comfortable and settled in your real work, with minds relieved of the burden.

After twenty years' service, you will obtain a step in relative rank and an increase of pay. After this, should you remain in the service so long, comes the next step of deputy surgeon-general. A period of five years in this grade adds materially to your pension (£250 a year). Should you be fortunate enough to attain the highest post of all, that of surgeon-general, and hold it for five years, your pension will receive another substantial increment of £350. But, though few may attain to this position, there are many other appointments even more lucrative, though not involving extra pension, some connected with the military service, others quite distinct from it. The appointments open to medical officers are fewer than formerly; still they are numerous, and I will tell you briefly what they are, or have been, since my own connection with the service.

In addition to the administrative appointments of surgeon and deputy surgeon-general, the following are now, or recently were, held by medical officers; principal and professors in all the subjects of an university curriculum in medicine, in the Colleges of Calcutta, Madras, Bombay, and also a limited number in the College of Lahore; superintendent of native medical schools at Agra, Nagpore, Patna, Dacca, etc.; these generally being held in combination with the office of civil surgeon of these important stations.

The important subject of medical education will be entirely in your hands, whether as members of the medical faculty, of the senate, or as examiners in the Universities of Calcutta, Madras, or Bombay, or as professors in the Medical Colleges. The new College of Calcutta, which was founded in 1833 by Lord W. Bentinck, is, I may tell you, the largest medical school in the world. When I left it in 1872 it numbered over 1,300 medical students on its rolls, and it is increasing every year. There is, perhaps, nothing that has exercised a greater political or social influence for good on the native mind, or done more to consolidate our hold on the affections of the people and the country, since the days when Broughton and Hamilton gained for the British power the earliest concession of privileges which gave us our first hold in the country from the Moghul of Delhi; and since when, in 1836, the learned Pundit Moodhosoodun Guptoo, laying aside the prejudices of caste, initiated the study of anatomy by dissecting the human body, than the study and extension of medical science in India. It will be for you to sustain and extend the prestige it has acquired, and there is, perhaps, no direction in which your talents and energies may be more usefully directed.

Among offices that may be, or have been, held by medical men in India, the following may be mentioned :—

Surgeons and assistant surgeons, and resident surgeons of the General and College Hospitals; superintendents of eye infirmaries; garrison surgeons; field surgeons and assistants to armies in the field; surgeon to the viceroy; surgeon to the commander-in-chief; presidency and district surgeons; marine surgeons; police surgeons; superintendent of lunatic asylums; superintendent of emigration; medical superintendent of emigration; medical examiner of accounts; principal medical storekeeper; other medical storekeepers; civil surgeons of stations, very numerous; and sometimes remunerative appointments, to which are joined others; regimental appointments; chemical examiners to Government; analysers of waters; assay and assistant assay masters; superintendent of botanic gardens, Calcutta, Scharunpore, and others; of cinchona plantations; forest appointments; superintendent of fisheries; sanitary commissioner to Government of India; sanitary commissioner of provinces; statistical officer and officers on special duty for investigation of cholera, held by two very distinguished students of this school, Messrs. Cunningham and Lewis; inspector-general and inspector of jails; superintendents of jails; inspector-general and superintendents of vaccination; political agents; assistant political agents; magistrates, coroners; commissioners and deputy commissioners of divisions, offices involving judicial functions; opium agents and assistants; professor of Arabic and secretary to Colleges (formerly); governor of the Andaman Islands (formerly); superintendent of Darjeeling, the late lamented Dr. Campbell; a former Persian envoy; and others that at this moment escape my memory. With many of these offices are combined other duties, or two or more may be held by the same officer.

In most cases, the civil and military medical appointments give opportunity for private practice. In the Presidency cities and larger civil stations, it is often considerable; and though, perhaps, not so lucrative anywhere as in former days, it is such as would compare not unfavourably with the results of medical practice in European cities. I have heard it said, that the late Dr. N., when surgeon to the General Hospital in Calcutta about thirty years ago, made as much as one lac of rupees, £10,000, a year. Things have changed since then; medical men are more numerous and honoraria are smaller. Those who realise half the amount are fortunate; but this is not equal to the same in England. The cost of living is great, and the expenditure large; but if health continue, most medical officers may look forward at the completion of their service to retirement with a competency. Unfortunately, health is not always preserved, and the position is forfeited by the necessity of seeking change in Europe. But, lest I should excite undue apprehension in reference to the evils of the climate, I will presently say a few words on the mode of life in India.

I have thus given you a glance at your future work, and an idea of what you may aspire to; I am sure it depends on yourselves how far you may profit by the advantages offered. In these days, though interest and the influence of friends will do something, they are as nothing to personal merit, which will do more.

To men of apathetic temperament, though correct in all their proceedings and relations of life and duty, the opportunities may seem never to come; but the real fact is, they are neither perceived, nor grasped when they offer, and the favourable moment passes by unheeded, perhaps not to return, and mediocrity is the result; but even to these the service offers something. There is sufficient for all present wants and a pension for the future. After periods of from seventeen to thirty years, you have the option of retiring on a pension according to the length of service, varying from £220 to £550 a year, or if the last five years have been passed in the position of deputy-surgeon or surgeon-general, you will add an additional £250 or £350 to your pension. A liberal allowance of leave is accorded, amounting to six years in the whole period of thirty years; but, unless under very exceptional circumstances, not more than two years can be taken at a time, and that after stated intervals. You will do well to avail yourself of this privilege, even though your health should not seem to require it, for it gives you the opportunity of renewing your home impressions, and refreshing your knowledge of professional subjects; and you will do very well, if it be permitted, to spend portions of your furlough here with that object.

Now, as to your mode of life in India, and indeed other hot and tropical countries, with reference to the preservation of health, I have not much more to say than that common sense and careful living are all that are required. India means every variety of climate, from the hot damp plains of Bengal to the dry arid plains of the north-west and Punjab, or the cold rarefied atmosphere of the Hill stations; and you must act accordingly. Temperance in all things; regularity of life and habits; avoidance of excessive, prolonged, or undue exposure to the direct rays of the sun and to malarious influences, especially as they occur in certain localities; attention to clothing, which should consist mainly of light woollen materials, to protect you from chills, and equalise the temperature of the body; plenty of, but not too much, work; sufficient exercise; plain food, and extreme moderation in alcoholic drinks of all kinds; and as little tobacco-smoking as possible—these precautions, if observed, will keep you in good health, and fit for work for many years; and you will find, I think, as a general rule, that men in India work as hard or as harder than they do here, for, from the time you occupy a position of the least responsibility, work goes on steadily increasing, and developing new motives to exertion.

Of course, in such climates as those of India and the tropics, one is liable to sudden and serious attacks of disease; but, escaping these, as you may reasonably, with care, expect to do, it is wonderful how high a standard of health may be preserved even under the hardest work and the greatest exposure. The tendency is to suffer as much from mental as from physical strain, and as many break down from overwrought brains as from physical exhaustion; but, fortified by such means as I have suggested, you may to a great extent bid defiance to both. I would repeat the advice that you should, if possible, avail yourselves, at reasonable periods, of the leave which the Government accords you to Europe. It is often said that the doctors and the indigo-planters, men who are most exposed, are the healthiest men in India. This is not, perhaps, altogether true; but it shows that the advantages of exercise, combined with mental occupation, are popularly recognised.

And now a few words to those of you who are destined for the Navy and Army. Though I cannot profess to indicate all that you may look forward to so well as I can to your Indian colleagues, yet this much I may safely assert, that for you, too, an interesting field of work is open; and, though the variety may be less than in the Indian service, yet it is equally interesting and important. To you will be committed the care of the health of our soldiers and sailors, and of our military and naval stations at home and abroad. Many of you will work side by side with your Indian friends. In the event of war—and who can say how long we shall remain at peace?—the treatment of our sick and wounded will also be your care. To you also it will fall to investigate the laws that govern the origin and diffusion of epidemic and other forms of disease; and, as your experience will be gathered in all quarters of the globe, your opportunities of studying the influences of climate will necessarily exceed those of all others, and will enable you to solve problems that are yet unexplained. Nor will your duties be limited to those of a purely military or naval character; for, though I am not sufficiently acquainted with all the details of your services to describe them, I know that there are many special appointments open to those who will aspire to them. In short, to whichever branch of the service you belong, you have before you an useful and honourable career, which will be useful and honourable just in proportion to your own application of the capabilities you possess. In no case, I fear, may you expect to acquire wealth. Were this your object, you should have chosen another profession; but competency, and the means of doing justice to your families, and of supporting the position you attain, you may realise; and if so, and you feel that you have served your country well, and to the best of your ability advanced the knowledge of your profession and the bounds of science, you may be content, for you will have gained that which will bring you the truest happiness and the best reward.

And now I must not detain you longer. I have already trespassed too much on the patience of all, and I will conclude by wishing you all prosperity and success in your present and future career.

ARMY MEDICAL SCHOOL, NETLEY.

THE prizes were distributed at Netley on 3d February 1879, at the conclusion of the thirty-seventh session of the Army Medical School, by Surgeon-General Sir J. Fayrer, K.C.S.I., LL.D., M.D., F.R.S., in the presence of Surgeon-General Massey, C.B., the P. M. O., the Commandant, the Professors, and a number of military and medical officers and visitors.

The following is a list of the successful candidates for commissions as surgeons in Her Majesty's Indian medical service, including the recipients of prizes:—

No.	Name	Marks.	No.	Name.	Marks.
1.	Sweeny, T. H. * †	5171	9.	Briggs, H. B.	4246
2.	Barry, D. F. **	5115	10.	Carson, W. P.	4235
3.	Harris, G. F. A.	5093	11.	Faulkner, A. S.	3836
4.	Anderson, J.	5073	12.	Mallins, C.	3834
5.	Bamber, C. J.	4618	13.	Damla, E. M.	3236
6.	O'Dwyer, M.	4604	14.	Allen, R. M.	3186
7.	Dumbleton, E. H.	4415	15.	Carruthers, H. St C.	3089
8.	Lowdell, C. G. W.	4264			

* Gained the Parkes Memorial Bronze Medal.
† Gained the Herbert Prize. ** Gained the Martin Memorial Medal.

The following were the successful candidates for commissions as surgeons in the medical service of the Royal Navy:—

No.	Name.	Marks.
1.	French, A. M.	3507
2.	Williams, E. H.	3504
3.	Fergusson, E.	3176

Sir J. Fayrer, after distributing the prizes, addressed them nearly as follows:—

Having completed the agreeable duty of distributing prizes to those who have earned those honourable distinctions, I now turn to that of addressing a few words to you on the completion of your studies at Netley, and on the eve of your departure to commence the work of your professional life.

I desire, first of all, to offer my congratulations to the Principal, the Professors, and the medical officers of the Army Medical School on the successful completion of another term, and on the very marked evidence afforded by the report that has just been read, that this institution continues to maintain its high standard of utility, and the candidates the discipline and conduct that becomes their position. I would also take this opportunity of warmly congratulating Surgeon-General M'Lean on his restoration to health, and express a sincere hope that his valuable services may long be continued to the institution, of which he has been for so many years its principal support, and a brilliant ornament.

I feel sure that no one can have seen this school and hospital, with its splendid appliances and machinery for medical education of a special kind, without recognising the great power it must exercise for good on the sanitary welfare of our army and navy, the civil

population of our colonies, and of India; nor can he have failed to observe how great is its capacity for even extended utility. For my own part, I have always longed to see it take a much more prominent part than it does at present in the education and final training of our young medical officers, and I hope the time may come when it will extend its instruction to a greater number, and over a longer period of time to each individual.

Among many rumours that have gone abroad in relation to impending changes in the medical service, there has been one that pointed to the abolition of the school altogether. I can hardly believe that a step so fatal to the best interests of the service should have ever been contemplated, or that if it had, it would ever have been carried into effect. I believe that no such future awaits it, but that it will rather increase in importance and extend its usefulness; that it will not only continue to maintain its present position as a great army and naval medical school, but I even hope that, as a sort of medical staff college, it will become more and more the resort of medical officers, who may here have the opportunity of renewing their knowledge, of keeping themselves abreast of the rapidly-advancing progress of medical science, and of fitting themselves for those special appointments that are so frequently occurring in the services, especially in India.

Times have been unfavourable of late years with the medical services, and many reasons have been assigned for the decadence. This is neither the place nor the time to discuss them or their results, especially when we have every reason to hope and believe that a better prospect is near. This only I would say, that the position of the military or naval medical officers ought to be such as to command an abundant supply of the *élite* of our universities and medical schools, and that it will do so when certain obstacles, which there is reason to hope will be removed, are out of the way.

Gentlemen, I believe a good time is coming, and I trust you will prove yourselves equal to support and do it credit when it arrives; and here I may say to you, what perhaps one not of your own service and profession neither could nor would say, that as some of the difficulties which have stood in the way of progress may have originated in the service itself, how greatly it behoves you all to see that such difficulties should in future be avoided. Important public duties involving great responsibility, if performed by men of education who are of accord in maintaining their self-respect and the dignity of their office in a spirit of unselfish loyalty, must command public esteem and respect, and must also bring social and official consideration and standing. Wanting these attributes, however high the esteem in which *individuals* may be held, that esteem will not be extended to them collectively as a service. I can imagine nothing better calculated than the training at Netley to imbue, foster, and develop that spirit, without which there can be no sustained well-being or real stability in any public service. These are merely *hints.* I leave it to you to make the application.

Gentlemen, I have to congratulate two of your number on the

acquisition of prizes all bearing the names of men who deserved well of their country, and who may rightly be held up to you and other young men, in whatever walk of life, as models for imitation. I trust the success implied in the winning of these prizes may attend you through life ; but I would ask you in the future not to regard them merely as souvenirs of a successful career at college, but rather let them act as incentives towards the attainment of that which made Sydney Herbert, Ranald Martin, and Edmund Parkes names of honour and respect wherever they are known, and that may in time to come perchance reflect lustre on your own names. All cannot win prizes, but all must have done well, that you are here at all proves it. I would just say to those who have been less successful than others, that there are many prizes in the career before you if you will take advantage of the opportunities that may offer. I do not undervalue college prizes—far from it, but I am bound to say that I have known men who, if they won none as students, gave signal proof in their after-lives that it was not from lack of ability. I have heard it said that the public services offer no inducement, that they are one dull level of monotonous equality, and that talent, energy, zeal, and the like, do little, or are of no avail more than mere good behaviour and compliance with official decorum and routine. I think this is hardly true here ; I am sure it is not in India. When I had the honour, four years ago, of addressing a similar audience here, I gave a sketch of the nature of the Indian medical service, and the appointments it offers to them who will try for them. I might repeat what I then said, but I shall content myself by saying that such appointments still exist ; and I think if some of those I then spoke to were here now, they would say I did not mislead them. I do not mean to say that good appointments are to be picked up without effort, or as blackberries may be gathered from every bush, but that they are sufficiently numerous to offer a fair prospect of success to all who really work for them.

Do not suppose there are no drawbacks in the Indian medical service. Climate, expatriation, separation from friends, would all refute the assertion if I made it. There are many appointments, too, with the bare military pay of the rank, and they are not very lucrative ; but still I assert with confidence, that no medical service in the world offers better prospect of professional advancement, and even pecuniary success. I need not, I suppose, remind you—you have doubtless found it out long ago—that in no case can one look for much wealth, or rise to high place in the scale of public honours ; but these, after all, are not everything : you may look to a useful and honourable life, to professional eminence, to the esteem and respect of others, and perhaps to the consciousness that you have done your duty to your fellow-men in a fashion that falls to the lot of no other profession (save one) to perform. As public medical officers you are charged with the life and health of our soldiers, our sailors, and sometimes of large civil populations, for whom you have to fight the great battle of disease, and against whose

inroads you have to defend the fortress of health. In India your responsibilities are very great, for you will find yourselves charged with extensive duties, and your experiences will be varied. Remember (as I said on a former occasion) that you are not merely the medical officers of the army there. You are the medical profession of a country as large as Europe, excluding Russia, and to some of you will be entrusted the duty of advising Government on the sanitary welfare of 240,000,000 of people. You will be the educational staff of the colleges, the consulting physicians and surgeons of the great centres of population. You will have charge of armies in the field and in garrison, to say nothing of a variety of other civil and military appointments that I cannot stay to enumerate. You will at least have a competency that makes you independent. If you are fortunate, you will have much more. You become entitled, after certain periods of service, to pensions for yourselves and your families, which, if not great, are certainly as good as the pensions of any other medical service; and you may hope to return to your native country at a time of life when you may still be useful to your friends, to yourselves, and to your profession. This is not such a bad prospect! In some respects, perhaps, the Indian medical service has fallen from its former high estate, but it still holds out prizes, and I can honestly say, after many years' experience, that I have not known any really good man to fail in the end. As to climate, with care and moderation in all things, you will probably preserve your health sufficiently to find yourselves equal to those of your own age at home, when you retire from the service.

Gentlemen, my remarks have been addressed chiefly to the Indian medical candidates. I have said little in reference to the British section of the service, for the simple reason that there are no candidates for that service to say anything to. I sincerely hope and believe that this is the last occasion on which he who addresses the Army Medical School will have to make this remark, and that at future distributions my successors will have the gratification of speaking to benches overflowing with candidates for all the three services. There is, indeed, reason, I hope, to think that it will be so. To my naval friends I have only to add that I offer them my best wishes for their success. To those, and there are such, who say that the naval medical service is not a hopeful one, I can only say that it is vastly better than it was when I belonged to it, and that it is still improving; and I would ask where Spencer Wells, Huxley, Hooker, and Macdonald were trained. It is a noble service, gentlemen, and your department of it is an important one. Be true to yourselves, be zealous officers and earnest workers, and loyal gentlemen, and rest assured that you will find in it, like the sister services, a field for an honourable career. I must not detain you longer. It only remains to wish you all prosperity and success in your respective services.—(*Reprinted from the Edinburgh Medical Journal for March* 1879.)

Presidential Address

AT THE

EPIDEMIOLOGICAL SOCIETY,

Delivered on November 5th, 1879,

By Sir JOSEPH FAYRER, K.C.S.I., LL D., M.D., F.R.S.

Gentlemen,—My first duty is to thank you for placing me in the honourable and responsible position I now occupy as President of this Society. I must suppose, whatever may be my own misgivings on the subject, that you recognise in me some personal or official fitness for the post, and it therefore only remains for me to endeavour to justify the selection you have made, though I confess I anticipate some difficulty in so doing. The duties of a Society with such aims as those of the one over which you have called on me to preside are of a very important nature; the questions it proposes to investigate are often of surpassing interest, and the influence it ought to exercise for the public good should be largely exerted and widely felt. To guide the affairs of such an institution seems to me to demand, in the person who holds the office of president, a combination of qualifications that I can lay no claim to: nevertheless, as you have been pleased to place me here, it will be my duty and my anxious desire to devote to your service such knowledge as I may have acquired during a long residence in India, where epidemic disease prevails; and for the rest, I can only crave your indulgence for such shortcomings as must occur in the case of one whose experience has been rather that of a practical physician than of a scientific epidemiologist; assuring you, at the same time, that no effort shall be wanting to promote the welfare of the Society.

On assuming this seat, I know it is my duty to inaugurate the session by a brief address on some subject cognate to the work before the Society, and I must therefore observe the usual routine; but I admit I approach it with some hesitation, for there is so much that might be said that I hardly know what to select as most appropriate to the occasion. I trust, however, that I shall not greatly err in selecting a subject connected with the Progress of Epidemiology in that great country which contributes to the British Empire 250,000,000 inhabitants, composed of many races; and territory as large as all Europe, excluding Russia—including every climate from that of the arctic to the torrid zone; and that is regarded by many as the birthplace and permanent home of the most terrible epidemic disease to which the human race is liable.

We are now entering on our thirtieth session, and, I trust, with reason to believe that our progress is satisfactory, and our work such as to prove that the Society is fulfilling the main object for which it was founded. Though not one of the largest, it is certainly not one of the least active or important among the medical societies of the metropolis, whilst the cosmopolitan range of subjects embraced within the scope of its inquiry renders its proceedings of far more than mere local interest.

The papers read and subjects discussed during previous years vindicate its title to a prominent place among institutions which have for their object the promotion of some of the best interests of mankind; and I can only express a hope that the session now commencing will not fall short, in this respect, of its predecessors.

As a comparatively new member of the Society, I have as yet had but little experience of its mode of working, and few opportunities of taking much part in its discussions, but I have learned enough of its objects and proceedings to know that they merit the best effort of the members for its support, and also for the elucidation of the important (and, in some cases, still undetermined) questions that come before it, and which so deeply concern the welfare of man and the prosperity of nations—problems relating to the genesis, diffusion, and prophylaxis of disease which, in the epidemic form, still so often prove the scourge of communities and the enigma of science. Such are the subjects it is our duty to investigate, and by degrees we hope in some measure to unravel. Nor need we doubt that in time much of what is now obscure will be made clear. When we think of what has been done but recently—how much has been learned by careful observation and generalisation, how beneficial has been the result of the knowledge as applied to sanitary work, and in the diminution it has effected in the death-rate, and when we contrast our present knowledge of idiopathic fevers and other diseases, the laws of contagion, and the natural history of entozoa, with that of but a few years ago, we may reasonably hope that the work of such a Society as this will be prolific of good results, aided, as I trust it always will be, by the experience of men who have studied disease, not only by the bedside of metropolitan hospitals, but in all climates in every quarter of the globe, in the army, navy, colonies, and in our Indian empire (which may be regarded as the head-quarters not only of epidemic, but also of some special form of indigenous or endemic disease). Regarding it from this point of view we naturally desire to have a large accession of members on our rolls, and to see a greater share of the interest that is so freely bestowed on the pathology and therapeutics of special forms of disease accorded to epidemiology, to disease in the aggregate, or as it affects the masses of the population, when, in obedience to laws with which we are as yet but imperfectly acquainted, it moves in and from city to city, over rivers and across seas, from province to province, from continent to continent, until at length it disappears apparently as mysteriously as it arose, though, no doubt, in conformity with constant and definite laws. No one can have watched the rise, progress, and decline of an epidemic of cholera or of fever, such as the dengue that last swept over India in 1872, with their apparent caprices of invasion and subsidence, activity and decline, without feeling how much he has still to learn before he can comprehend the import or reason of it all, and how essential it is that we should study, with all the aids that science can bring to bear on the inquiry, the complex and recondite agencies or forces that control the origin and movement of epidemic disease; patiently studying its various phases and phenomena, carefully substantiating facts, not allowing ourselves to be unduly influenced by the bias of preconceived theories, and endeavouring to record these facts *as they are*, and not as how we think *they ought to be;* for thus shall we gradually accumulate

reliable data from which to generalise, and on which principles may be based and laws established. Nor is such caution superfluous, as I think will be admitted by some who have had to deal with sanitary reports.

The *raison d'être* of this Society is the investigation and development of our knowledge of disease in motion. It involves much, for any disease where it spreads, whether among the people of a house, a ship, a village, a city, a province, or a continent, is an epidemic, and comes within the scope of our inquiry. Dysentery and malarious fevers are typically *endemic* diseases, but in India they may and do at times assume a dangerously epidemic character. But it is not meant that our inquiries should be restricted to mere epidemicity alone; we cannot advantageously study one phase of the natural history of disease and exclude others. There is so much in etiology, semeiology, and pathology both human and comparative, that concerns our department of research that we may not ignore the means by which we gain the most important of all information to the epidemiologist—namely, the means of discriminating one form of disease from another. Therefore, though our proceedings will naturally refer mainly to epidemic disease, we shall thankfully receive and carefully consider all information that may tend in any way to throw light on the causal relations, and on the influences exercised by climate, season, locality, food, and occupation on the genesis and dissemination of all diseases, not excluding those of the lower animals, or even of plant life. I might illustrate this by referring to the importance of discriminating between the different forms of fever that occur in India. It is well known that the greatest proportion of mortality in India is ascribed to fevers. The highest death-rate[1] was registered in Bombay, where it equalled 20·82 per 1000; in Madras, the deaths of 469,241 persons gave a death-rate of 10·08 per 1000. Both here and at Bombay, however, the mortality recorded was greatly aggravated by famine. The statistics of "fevers," in all years, are admitted to be most inaccurate, but the deaths registered under this head in the different provinces during the year 1877 were as follow:—

Bengal	711,037
North-west Provinces	574,722
Punjab	219,281
Central Provinces	131,123
Berar	34,453
British Burmah	261,001
Madras	469,241
Bombay	336,865
Assam	18,725
	2,756,448

In 1878 there died in Bengal, of diseases classed as fevers, 742,887 persons (419,294 males, 323,593 females). The total death-rate from these diseases was 12·38 per 1000, against 7·58 per 1000 average on the previous five years. Part of this may be attributed to better registration.

In 1877, out of a population in nine provinces of India of 181,929,889, there died of fevers 2,521,438; whilst of cholera 635,977 died. In 1874 only 81,266 died.

[1] Vide Report of Sanitary Commission of the Government of India for 1877.

In his report for 1878 the sanitary commissioner, Dr. Little, of the Hyderabad assigned districts, shows that there was exceptional mortality during that year. In a population of about 2,186,988 the death-rate was $81\frac{1}{2}$ per 1000 in 1878, against 32·1 per 1000 in the previous year. The total deaths in the year were 178,404, and the causes were as follow, fever being the most prominent:—

Death causes.	Total deaths.	Deaths per 1000.
Cholera	34,306	15·6
Small-pox	5,850	2·7
Fevers	85,260	38·9
Bowel complaints	27,577	12·6
Injuries	1,147	·5
All other causes	24,264	11·1
All causes	178,404	81·4

This great mortality is probably partly attributable to the indirect influence of the famine, which deprived the province of much of its most wholesome food by causing exportation of grain to the famine districts. The population to a great extent thus subsisted on an inferior, or deteriorated, kind of grain. There were other local climatic causes, but to these I need not allude. I refer to the subject as an evidence of the great mortality of fevers as compared with other diseases.

There is no doubt that, under the heading Fever, many deaths from other causes are recorded, and we may probably refer a large proportion of them to diseases of an inflammatory character affecting the thoraic or other viscera, or to complications involving inflammatory action elsewhere. In a vast country like India, where the population is so extensive, and the means of registration of necessity limited, often not under medical supervision at all, it is not to be expected that greater accuracy can be ensured; but, were it possible to discriminate among the various forms of disease returned as causing the mortality by fever, we should have a very different result from the present. One can hardly refer to this subject without expressing admiration at the great progress that has been made of late years in registration under the direction of the sanitary authorities of India, and confidence that it will continue to improve, and render the statistics more valuable even than they are now. Of course, where the registration of death is not subject to medical definition, discrimination between the various forms of fever or other death-causes could hardly be expected; and therefore the example I have just given is hardly so good an illustration of what I refer to as typhoid, for which we have accurate medical statistics of our European troops in India. It is within my recollection that attention was first called to the existence of this form of fever in India, and yet there can be, I suppose, no doubt that it has always been there. It soon became generally recognised as a new discovery in India, and people wondered how it had escaped observation hitherto, whilst some perchance regarded it as a new disease. But it was just this power of discriminating observation that is so rare and so valuable that had been wanting; it was this that, exercised by Budd, Jenner, Murchison, and others after them, established a new era in the nosology of fevers in England; and it was this that, a little later, in India, discriminated between certain forms of remittent and enteric (*i.e.*, between

malarious and specific) fevers, and that will, I hope, ere long further discriminate and rearrange the nosology of fevers in India and the tropics.

Now typhoid or enteric fever is an important cause of mortality among our young European soldiers in India; and it raises or suggests questions of great importance in regard to them—such, for example, as the right age, time, and seasons for sending them to India; to say nothing of the hygienic questions as to sanitary measures arising out of its causal relations. The Sanitary Commissioner's Report of 1877 says that out of 233 cases of typhoid, 92, or 39 per cent., proved fatal; the admission rate being 4·1 per 1000 of strength. It moreover appears that 2·45 per cent. occurred at or under twenty-four years of age; 1·55 at twenty-five to twenty-nine; 0·99 at thirty to thirty-four; and a few or none above that age; showing that the disease tells most severely on the younger men—in this respect resembling typhoid in England. Again, Bryden, in his Report of the Statistical History of the European Army in India up to 1876 (published 1878), says: "It has no geography; and it is a matter of popular observation that no regiment or battery escapes enteric fever *in the first year*, whatever cantonment of India may be selected." "Out of seventy-three bodies of men two regiments and seven batteries only returned no case of enteric fever in the first year." And he gives the following analysis of 368 deaths that occurred between 1823 and 1876:—

Ages.	Total deaths.
24 and under	255
25 to 29	90
30 to 34	17
35 to 39	4
40 and upwards	2

Seventy-five of these deaths occurred within three years after landing in India, and 94 per cent. of the total were among men under thirty years of age. In a memorandum received only a few days ago Bryden says, out of 132 deaths from enteric fever in 1878, 90 occurred in men who had been under twenty-two months in India. All this shows that youth and the first year of service in India are the great predisposing causes.

Now is this the same disease as that which might be contracted in London, Dublin, Windsor, or elsewhere in a town or barrack?—from a watercloset, drain, sewer, well, or, it may be from a milk-can? I have little doubt that very frequently it is exactly identical; but I believe also that perhaps as frequently, or more so, it is not; and this, I believe, not in regard to young European soldiers only, but of the whole population of India. In short, I am, and long have been, of opinion that a form of fever exactly like European typhoid, except in its etiology, exists in India and other hot and malarious countries; and that it is due to climatic causes, not to filth or specific causes such as give rise to it in England and elsewhere, and recent reports from India and other parts of the world seem to show that this view is gaining ground. I am indebted to Surgeon-Major A. Clark for the following note:—

"Typhoid fever has prevailed very extensively in Natal and Zululand during the war. Since Jan. 1st, 1879, to May 31st, no less than 267 admissions for enteric fever have been recorded. Many of these occurred in healthy camps on ground previously unoccupied (virgin soil), and in bodies of picked men. The water supply, as a rule, good; no

sewers or drains; conservancy, dry earth or trench, and carefully attended to. The troops of Crealock's Division, which were encamped near the coast and in close proximity to marshy ground, where the natives suffer severely from remittent fevers, had more admissions from enteric than the Second Division, which was inland and generally at higher elevations. The medical officers differed as to this fever, several maintaining it was not typhoid as commonly understood in England, but bilious remittent with typhoid symptoms, as seen in India; others nailed their colours to the mast that it was genuine enteric. In support of the former, a medical officer just home reports that numerous cases entered as enteric were discharged, and at their duty five or six days afterwards. Surgeon-General Woolfreyes describes this fever as 'typho-malarial.' He says: 'It is not a fatal fever, but it causes great prostration, and a change to England is absolutely necessary. I am of opinion that it is climatic, the true autumnal fever. It, as a rule, commences with sore-throat, a peculiarity; the rose spots are invariably present, and in fatal cases the lesions of Peyer's patches are well marked.' At the time that enteric was reported so common in the First Division, jaundice also prevailed very extensively, but was unknown in the Second Division. Enteric has also been reported as causing much sickness amongst the troops in Afghanistan. Here, again, camps were often pitched on virgin soil, though the water supply was far from satisfactory, and dead camels so constantly polluted the streams. It prevailed *with* cholera and severe remittent fevers. Altitude made no difference, cases being admitted in camps several thousand feet above sea-level. Enteric cases are reported from nearly every station in the Bengal Presidency, some such as Cambellpore, in the Punjab, where the 'filth' element is at a minimum. At this station there is no large bazaar or city in the vicinity; the soil is arid, sandy, and very dry; the rainfall exceedingly small; water-supply good, and very carefully filtered and attended to; the dry-earth conservancy is carried out to perfection; the milk danger is almost *nil*; yet enteric occurs, and amongst the troops who drink hardly any milk, while the women and children who probably drink a good deal of bazaar milk have so far escaped. These facts seem to show that enteric fever cannot be always ascribed to a 'filth' cause, but that climate, or what is embraced in that unknown word, 'malaria,' may give rise to it as it undoubtedly does to intermittents, remittents, and *possibly* cholera."

Be it clearly understood, however, that I do not for a moment dispute the existence of genuine *filth* typhoid in India. The official returns, which cannot be gainsaid, and my own experience alike leave me in no doubt about it. But I do believe that many cases now recorded, and rightly recorded, as typhoid in India, are not caused by the same specific agency as that which gives rise to typhoid here, and also in India, where the necessary conditions are present. That there are, in fact, two, perhaps more, forms of typhoid, or perhaps, I should say, different causes for a disease presenting the same phenomena, one being specific, the other climatic; if so it is obviously very desirable to discriminate between them—not merely as a matter of nosological or pathological interest, but in regard to the hygienic measures that are necessary in either case. This question is of great interest to epidemiologists, and

is just one of those subjects that should come within the scope of our inquiry. A remarkable instance occurred near London lately, where an *epidemic* of typhoid was traced to its origin along the track of a particular water-supply by a distinguished member of our Society. Our lamented colleague, Murchison, also traced a similar outbreak to contamination of milk by polluted water. The explanations of these outbreaks were exactly in accordance with these views, no doubt, rightly held in Europe. Typhoid in India, however, would not always be similarly explained.

Questions of this nature are, I think, such as might be advantageously discussed here. I am aware that great differences of opinion exist among those whose views command the highest respect; now, to compare ideas, to discuss, and, it may be, to reconcile differences, to clear up doubts for ourselves and others, to confirm or refute, seems to me to be our legitimate work. Our views on a particular subject may be unsettled; they may be influenced by preconceived theory, and altogether far from confirmed. One can understand that a cautious and reflecting mind may desire more evidence before accepting either view presented as the correct one, or before admitting that it has been convinced. In regard to some questions of etiology such, I believe, is far from an uncommon frame of mind. The consideration of such vexed questions is most desirable. Let us hope that free expression of opinion, and temperate discussion of views, however opposite, will here be attended by good results.

The late Mr. Bedford, whose comparatively early death was deplored by the Bengal Medical Service, of which he was a brilliant ornament, said in a letter to the President of the Society in the year 1850: "Epidemic diffusion is the most important medical question of the day, and can only be studied through systematic and parallel observations conducted by a number of intelligent men working under one head. India, from its climatic peculiarities and the nature of the service, offers, I hesitate not to affirm, the most magnificent field in the world for carrying out such a series of connected observations as may tend to elucidate the laws of the most terrible disease which flesh is heir to, and it will redound to her eternal honour to be in advance of such inquiries." Whether these aspirations have in any way been fulfilled will appear from what I have to say; it will, I think, be seen that India has contributed in no small degree towards the attainment of the end so much desired; and that we owe much to the labours of those distinguished men whose writings, published in monographs, in reports, and official returns, afford ample proof how earnestly they have laboured to advance our knowledge of disease. The names of Jameson, Scott, Annesley, Twining, Martin, Mackinnon, Morehead in earlier times; of Goodeve, Chevers, Mouat, M'Lean, Bedford, Ewart, Bryden, Murray (our late distinguished president), the Cunninghams, Payne, Lewis, Macpherson, Cornish, Macnamara, Hewlatt, Townsend, Coates, Planck, and many others subsequently, to say nothing of the numerous valuable medico-topographical reports by the medical service generally, represent a literature of epidemiology that is unsurpassed in richness of its material, and affords evidence that the subject has received and is receiving elucidation that bids fair in time to throw such a flood of light on the natural history of epidemics as will reduce our knowledge to a state of exactitude hitherto unknown. They have, it is true, taught us

but little of the nature of the causes of epidemics such as cholera, or of malarious diseases, but they show what may be expected in regard to them, when and how they will appear, and how sanitary work may be made most effectually to avert, prevent, control, mitigate, or remove them; nor is it too much to say that we hope, if not to banish or stamp out, at all events still further to mitigate their ravages. This, I think, is warranted by experience, for certainly the past twenty years have witnessed great progress, and we already see that not only is the value of life increasing, but that the virulence of, and mortality caused by, epidemic disease are being controlled, whilst the vexatious and purposeless restrictions and restraints of quarantine are diminished if not altogether removed, in our dominions at least. Science that has enabled us to reduce the death-rate among our troops from 17·9 to 8·56 per 1000 in Europe, and from 69· to 17·62 per 1000 in India, speaks for itself; and were there no other result this alone is a triumph such as has been achieved by no other department of knowledge. Pray do not suppose that I claim all this for Indian workers. We all know that these great steps in social and sanitary progress began here, but I do say that the torch then lighted has since been worthily and firmly borne in Indian hands.

This Society, young as it is, can remember the commencement of systematic sanitary work in the East, and may claim some share in the origination of the good work; for among its earlier members were some who advocated the study of epidemiology and hygiene in India. I cannot now stay to dwell on this, but I may say briefly in regard to its progress and work that until the sanitary department was formed, less than twenty years ago, comparative, I might almost say complete, ignorance on the subject of epidemics, and of the diseases that prevailed among the people, existed. An epidemic might carry off thousands, but we knew not where it commenced, where it ended, or what area it occupied. Now, thanks to the continued and careful statistics, we know all that and more with fair accuracy, and are gradually collecting facts which make the study of epidemiology possible. Before organised sanitary work in India began our knowledge of the general population—nay, even of the European troops and prisoners—was most imperfect. Now, thanks to that department, and especially to Bryden, whose name cannot be too prominently mentioned in connection with the subject, we have, in his most elaborate and valuable statistical reports, facts and figures, as well as deductions, which deserve the closest attention. We have, in short, the most complete details of sickness and mortality in all classes over the whole of India. It is impossible, however much anyone may differ from his conclusions, not to recognise the great value of his work, for these reports contain a vast and continued array of authenticated facts which will serve as a mine of information to epidemiologists; and there is every reason for believing that it is but an earnest of more; for if, as Bedford said, the circumstances of India were such as to favour the acquisition of knowledge in 1850, when the precise conditions of life of the population generally, and even of our troops and prisoners were imperfectly known, what must it be now when a system of observation, carried out by a body of trained observers under a head such as he contemplated, is in full and daily improving operation? One can only wish that, considering the magnitude of the work, it were more

extensive still, and that observations, already of the greatest value, could be rendered still more so by being concentrated on certain limited areas so as to enable the inquiry to extend to details with a precision that at present can hardly be practicable. The results of epidemiological knowledge and sanitary work are seen in the effect already produced in reducing the mortality from cholera and other epidemics, and from malarial fevers. For instance, among our European troops, the circumstances of which are well known, there has been the following alteration in the general death-rate :—

1861 to 1865	..	..	9·02 per 1000.
1865 to 1870	..	..	6·98 ,,
1870 to 1875	..	..	3·23 ,,
1875 to 1876	..	..	2·3 ,,
1876 to 1877	...	..	·84 ,,

And it can be shown from the same source (Bryden) that there is a similar reduction in the death-rate among native troops; and that, during the great cholera epidemic that prevailed in 1876, the death-rate among the civil population being 12·12 per 1000 (it was the famine year) that of the European troops was 1·75 and of the native army 2·2 per 1000. Also that in the death-rate of that great scourge of India—fever—there has been an equally happy result, as shown by the death-rate of a period of nine years—from 1868 to 1877—in the Bengal and N.W. Provinces gaols, as against a mean, in nine years ending 1867, of 22·41.[2]

	Per 1000.		Per 1000.
1859	13.76	1868	2·84
1860	49·19	1869	4·57
1861	38·14	1870	6·20
1862	30·81	1871	5·81
1863 .. .	25·44	1872	1·92
1864	29.96	1873	1·56
1865	7.65	1874	2·67
1866	5.23	1875	3·50
1867	3.12	1876	1·26
Mean ..	22·41	Mean ..	3·29

In India, as elsewhere, the purpose of epidemiological study is to observe accurately and to interpret the import of the facts—*i.e.*, if possible, to elucidate the laws of which they are the expression,—and thus to form a scientific basis on which to direct sanitary work, which itself is the practical outcome of such observation, and concerns itself but little with theories. Those who have to do with it know how difficult it sometimes is to obtain *reliable* observations, such is the difficulty of excluding the bias of preconceived theory of the nature of the subject under investigation. Our Society, however, must hold the balance, and deal with theories as well as facts. No doubt the explanations sometimes are conflicting. Happily, in the practical mode of dealing with the question, there is not much conflict, and it is remarkable how little different is the action of those who hold opposite opinions on the causation of disease. As to the different views that are held in

[2] Bryden's Report (1876), p. 157.

regard to fundamental questions regarding the genesis and diffusion of disease let us hope that we may, perhaps, here contribute something towards their adjustment.

In illustration of the state and progress of epidemiology in India I might select the history of any of the great epidemics that have occurred of late years, but it would be impossible, in the short space of time at my disposal, to do this completely. I shall, therefore, confine myself to a few remarks on cholera, as it, though far from being the most destructive, is the epidemic to which most interest attaches. No disease has been more carefully studied, and the means of doing so exist nowhere so abundantly as in India, for whether in the sporadic, endemic, or epidemic form, it is seldom absent from some part or other of the empire. In the so-called endemic area in Bengal the opportunity of studying it is never altogether absent, whether it be sporadically or moving as an epidemic within the limits of the endemic area (its permanent home), or in the periodic outbursts, when it passes over the continent generally in what seems a capricious manner, but according to what really, as shown by Bryden, is the operation of laws that are now beginning to be well understood. The mode of invasion and diffusion, the rise and decline, the influence of locality, season, meteorology, conditions of soil, air, water, food, are all now closely studied, and to them various degrees of importance as factors have been assigned by different observers; and from the statistics conclusions have been drawn by Bryden and others that point with considerable force to the nature and the constancy of certain laws governing the progress of the disease; and albeit they have not as yet resulted in any very striking discovery, they seem to show that climatic and local phenomena form an important basis of a useful knowledge of the etiology of cholera, whilst the researches of Lewis and Cunningham point to certain conditions of soil as determining its production and development, as being most in accordance with the phenomena of its seasonal prevalence in the endemic area. But their prolonged and careful researches have as yet thrown no new light on the nature of the cause itself. Though it is only recently that this numerical method of dealing with epidemics has obtained in India, it is to be remembered that much valuable information has been recorded in times past in the writings of those to whom I have already referred and others, and in the records of the Medical Boards of the three presidencies, and reports of the sanitary commissioners. Indeed, since the advent of the Portuguese in the sixteenth century it has been described so graphically that one can hardly doubt the identity of the disease mentioned in early writings with that of the present day; in fact, it has as well defined a history as any other event of the past, and seems to have manifested the same phenomena, and to have been subjected to the same laws then as at present.

The theory that cholera is purely of Indian origin, and that wherever it may appear it is to be traced back ultimately to the delta of the Ganges, is disputed by some who see in history evidence that it has long existed in other parts of the world, and that it was described by the earliest writers—Sanscrit, Greek, and Arabian. I may here just remark that the name "haida," or "haiza," used by Rhazes nearly 1000 years ago in describing the symptoms of cholera is the same as that applied to it now by every Hindustanee-speaking native of India. As to its presence in

India from earlier periods we have descriptions by Correa, d'Orta, Bontius, and others, beginning from 1503. An epidemic of it in and about Goa in 1543, for example, is described by d'Orta, giving all the characteristics that distinguish an epidemic now. He calls it "moryxy" and also "haiza." It is described by a continuous chain of writers as occurring in various parts of India, in the interior as well as on the coast, up to the seventeenth century, when, after being quiescent during the latter part of the eighteenth and early part of the nineteenth century, it broke out with great virulence in Bengal, and has remained there ever since, in what Bryden calls its endemic area, whence it spreads according to certain laws, which are being worked out with admirable patience and intelligence by this distinguished statistician. I cannot now trace the history of cholera in either East or West, nor refer even to the numerous authors who have described it. For full particulars on this subject I refer you to Inspector-General Dr. J. Macpherson's learned work "The Annals of Cholera."

I need hardly insist that cholera is not a new disease, or that it did not, as supposed by some, make its first appearance as an epidemic in Jessore, in Bengal, in 1813; though no doubt since that period it has been more closely investigated and described. All seems to show that it is the same now as formerly, and that though we have gained much knowledge of its natural history of late years, yet we are as ignorant as our predecessors of its real nature. We have, thanks to sanitary measures, disarmed it of some of its terrors, and have diminished the mortality it caused; but as to treatment we have gained but little, though the empiricism of to-day is more scientific than it was in former days. We do not now burn our patients on the soles of the feet, tie ligatures round their limbs, or have recourse to other senseless barbarities; for we find that simpler and more rational methods are of greater avail, more or less according to the period of the epidemic at, and the promptitude with, which the remedies are applied. But we have learned that local causes have a potent influence, and that cleanliness, good air, *pure water*, and free ventilation are all powerful opponents of cholera; that we can predict its appearance and avoid it in certain places; and that it is not to be controlled by quarantine or sanitary cordons. And, from the earnestness and intelligence with which the subject of its etiology is pursued, it is not improbable that sooner or later it too will be made out. We shall then be in a position to say, not only what it does or will do, but what it *is*. Meanwhile we must go on observing and investigating. It is satisfactory to know that we are daily learning, practically, better how to deal with it, and how to modify its cyclical intensity and avoid its ravages. For my own part, until I know something more of the *nature* of the cause—be it a material poison, aerial or telluric, a miasm, or a dynamic agency that so perturbs the vital energy, I cannot see my way to formulate a definite theory either of the nature of its origin or the method of its diffusion. I find the highest authorities at complete variance on the subject, and reposing faith in theories diametrically opposed to each other. Some explain all the phenomena by contagion—*i.e.*, communicability in some way of a *materies* or germ from one person to another. Cholera, they say, is the result of infection by a poison derived from the intestines, and water or air, but especially water, is the channel through, by, or in which the infective

material is intensified and conveyed. These arguments are supported by an abundant array of facts, and have been maintained by men whose very names carry conviction. Others reject altogether this explanation ; they insist that local influences are all-important, and deny that the spread of cholera is due to human intercourse, that there is any poison transmitted by the excreta, or that the disease is in any way communicable from one person to another. They admit the existence of a poison of some sort—a miasm or an influence, though of its nature they are ignorant. It is a subtle thing that travels in certain directions in obedience to certain laws, is influenced by atmospheric and telluric conditions, and where it finds certain local conditions, and the people prepared by them to submit to it, there cholera will prevail. They deny the efficacy of any enteric or specific poison in the water to produce it, though they attach the greatest importance to the purity of water from *all* organic contamination, impure water being one of the local conditions which, if added to crowding, filth, or other insanitary conditions and want of proper ventilation, is that *of all others* which favours cholera. Such are the principal theories of the disease as they are supported by fact and argument which appear convincing. Europeans, Americans, and some authorities in India maintain the contagious view, whilst high authorities in India adhere to the opposite theory, and declare roundly that the facts of cholera, in India at least, are altogether opposed to the contagion theory.

Dr. Coates, in his last report on Bengal for 1878, says : "Much has been written and much discussion has taken place during the year regarding the connexion between cholera and foul water. We have not yet discovered the poison of cholera, nor even if there be one. To limit the cause of cholera to one factor, and its entrance into the system to one mode only, would be very unwise. Short of demonstration, the objections against such inferences must be great. Notwithstanding this, I confess that every year's observation, in going from district to district, in hearing the various opinions of the local officers on the subject, and in reflecting on both, my conviction has become stronger and stronger that there is a connexion between impure water and cholera, and the one—in Bengal, at least—is the chief (I would not make it absolute or conclusive) exciting cause of the other. Wherever the drinking-water has been most perfectly kept free from impurities, and especially local ones, there cholera has prevailed the least."

I have no intention now of entering into the controversy, and have merely referred to the main points of difference that exist among those who, having watched the disease closely and critically, are equally entitled to be heard. So far as I can see no theory yet propounded meets all the difficulties, or explains all the phenomena manifested by cholera, at least in India. There is much in each that commends it to acceptance, though each is beset by difficulties. So far as I can judge the direct contagion theory has now few supporters anywhere, for few believe that mere contact with the sick is attended with danger, and many believe the same with regard to the excreta, the enteric contamination of water—the water theory, in fact. This is not the time or occasion on which to offer an opinion on the matter ; but I must say that, as far as my experience goes (and it has been pretty extensive), it inclines me to look for the explanation in wider and more general causes than those of infected water only.

I feel unable to declare myself an unqualified adherent of any theory yet propounded; the time, I venture to think, for dogmatising has not yet come. We may, I believe, neither accept nor reject altogether the contagion theory. I doubt if anyone can feel so confident as to say that cholera is altogether independent of contagion or, in some sort, of human intercourse for its diffusion; or that it is not so imported or conveyed to other localities. It is possible that it may play a part, though a subordinate one, in the transmission of the disease; and yet I apprehend one must look for other and more general causes to account for all the phenomena. It must be borne in mind also that there may be influences and forces at work of which we know nothing, and that cholera may have different modes of working in India from those in Europe. It is so with other epidemics. Yellow fever is subject to certain laws within certain parallels of latitude, or rather isothermal lines, but beyond these it is extinguished. Scarlatina can barely exist in India; it dies almost as soon as it is born. Cholera thrives for a time in other climates and countries, but perhaps under other conditions than those of India, and does not endure. That may be signally true of it in India which is only partially so in other climates, and the laws which regulate its diffusion may not be—probably *are not*—alike in all countries where it has occurred. We are hardly in a position yet to act on any theory that has reference only to its origin. Strangely enough the two most opposed in nature as working hypotheses, seem to have very little influence on the mode in which they are practically applied to sanitary work.

I would quote some words of a former president, Dr. B. G. Babington, which are not inappropriate:—"In the infancy of geology, first studied in this country, many phenomena observed in the arrangement of the earth's crust, as it is found on this island, were supposed to furnish fixed laws, and thus gave rise among our philosophers to divers ingenious generalisations. But when these same philosophers had, from the establishment of universal peace, the opportunity of taking a wider range and of studying the earth's structure, not in this country alone, but over the whole surface of the globe, they discovered in many instances that what they had supposed to be general laws were after all only exceptional cases. We require, therefore, in a study of epidemic diseases, as of geology, a wide field, in order that we may found theories on a sufficiently broad basis to avoid the risk of coming to partial and erroneous conclusions."[3]

On the question of importation of cholera in the Punjab epidemic (1875-6) and its spread by human agency, Dr. Bryden, in his report, p. 308 (1876, published 1878), says:—"The assertion amounts to this. The Punjab is divided into thirty-two districts. Cholera was introduced into seventeen of these in 1875, and therefore it spread. Cholera was *not* introduced into fifteen districts, and therefore did not appear, or, if it was introduced, influences of which we know nothing stopped its propagation in these districts. Unknown causes prevailing in the one half of the area are presumed to influence the human system so that it is capable of receiving cholera, and in the other to act universally as an antidote even to a cholera poison when introduced. This is what is offered as antagonistic to the theory which asserts that cholera is air-borne and is as far-flying as are the limits of natural areas. Primarily, these theories cannot

[3] Address to Epidemiological Society, by Dr. B. G. Babington, December, 1850.

be reconciled; the one or the other is false. If cholera is spread only by the human being, the theory which shows it to be air-conveyed is untrue; if cholera is spread solely as an aerial miasm, then the theory which recognises only the effects of human intercourse is unfounded. The most that is admitted by the advocates of the human theory is, that the subjection of cholera to meteorological agencies is absolute, and that these influences can, and do operate so as to do away altogether with the effects of the poison, although imported. They do not recognise the entity *minus* the human being. The antagonistic theory, while holding, as opposed to demonstrable fact, the statement that cholera moves only by human agency, may, if necessary, be extended in its scope so as to embrace the other; that is to say, the inquiry is left open as to whether or not the cholera entity, after being aerially distributed, may be subsequently propagated or spread by man. In the theory which connects cholera solely with man there is no such extensibility. Human intercourse must explain every fact of spread and propagation, and nothing is left to the play of natural agencies. Human intercourse, giving the widest scope to the signification of the term, cannot pretend to account for any fundamental phenomenon displayed during the progress of epidemic cholera; and, therefore, I assert the theory to be radically untrue as applied to the behaviour of cholera in India. I do not say that the above statement will hold true all over the world; and, even as applied to India, the theory does not preclude the possibility that cholera may be conveyed by the human being. Naturally the recoil is to the opposite extreme. The bold statement that cholera is never spread over an area unless human agency intervenes, is apt to be met by the equally dogmatic statement that cholera is as pure a miasm as malaria, and as little amenable to the control of man."

I would, in passing, just remark on some curious and interesting facts regarding the introduction of epidemic disease into certain localities where the exact conditions of the people and the visitors were known. The nature of the miasm or influence is altogether unknown, but it can hardly be doubted that something was imported. Doubtless, as science progresses, epidemiology will give a simple and rational explanation of such things, and it seems to me probable that the diffusion of epidemic diseases may have to be explained on some law of which the following instances are only varieties of expression.

St. Kilda is one of the outer Hebrides, a small island N.W. of Scotland. In a work on this island by Mr. George Seton, M.A., Oxon., mention is made of a peculiar form of epidemic influenza known as the "boat cough" or "stranger's cough," having all the symptoms of influenza. By this the natives are almost always attacked shortly after the arrival of a vessel from the outer Hebrides. They allege that the disease is most severe when the visitors come from Harris, and that they suffer less when the vessel hails from Glasgow or the distant ports. The malady first attacks those persons who have come most closely into contact with the strangers, and then extends itself over the whole community. By some it is attributed to the inhabitants exposing themselves to cold by rushing into the water to assist the strangers in landing, but this is not a probable explanation. Others allege that it is due to easterly winds, but the ships generally arrive with a westerly wind. By some it has been remarked that the cough is a yearly epidemic, but Mr. Morgan assures us that three

outbreaks have occurred in eight weeks, each following the arrival of a boat or vessel. It has been suggested that the sudden contact of a people, under exceptional circumstances as regards food and occupation, with strangers, is the cause which seems to exercise an infectious influence on them, though what the nature of it is no one knows.

Again, on the river Amazon, speaking of the gradual exhaustion of certain tribes friendly to the whites who inhabit the country near Ega, Mr. Bates says: "The principal cause of their decay in numbers seems to be a disease which always appears amongst them when a village is visited by people from the civilised settlements—a slow fever accompanied by the symptoms of a common cold, *de fluxo*, as the Brazilians term it, ending in consumptión. The disorder has been known to break out when the visitors were entirely free from it, the simple contact of civilised men in some mysterious way being sufficient to create it."

A still more recent, as well as a more strictly parallel, illustration of the occurrence of the malady in question in another part of the globe is contained in the account of the cruise of H.M.S. *Galatea*, in 1867-68, where the following statement occurs:—"Tristan d'Acunha is a remarkably healthy island; but it is a singular fact that any vessel touching there from St. Helena invariably brings with it a disease resembling influenza. St. Kilda, off the west coast of Scotland, is known to be similarly affected whenever a party lands amongst the people from any vessel. Whatever may be the real cause of the mysterious ailment—whether it is produced by contagion, like certain other epidemic diseases, or by a feverish excitement arising from a contact of a higher with a lower civilisation—the actual occurrence of the distemper seems to be fully established; and the experiences of Ega and Tristan d'Acunha afford interesting illustrations of somewhat similar results in many different parts of the world."

Does not this seem to point to some subtle influence, the nature of which is unknown as yet? May not this in some measure account for the rapid decrease of the population of the South Sea Islands after contact with Europeans; and is it not pregnant with suggestive ideas as to the nature and the cause of transmission and diffusion of other epidemic diseases?

To return to cholera. In the present state of our knowledge we can only be guided by the inferences from well-ascertained facts and such laws as we have ascertained to be in constant operation, watching and carefully observing until we may, were it only by a process of exclusion, arrive at some deeper knowledge still. "So far," says the chief sanitary authority in India, "the history of cholera is full of enigmas and seeming contradictions; and though we have of late years collected many valuable data, and understood the importance of studying them on a broad basis, we know no more of the exact cause of the disease than our grandfathers did. We know that, whatever the cause may be, it flourishes in the midst of insanitary conditions of dirt and overcrowding, and especially of impure water, impure from whatever cause; we know that it is liable to occur under certain conditions, and at certain times and seasons, and we should endeavour to extend that knowledge, and hope, as we do so, to arrive at the precise nature of the disease itself." But it may be well to remember that "expenditure of public money must take place only on

observed facts and experience," not in accordance with theories. "It would be prejudicial to real sanitary work if opinions which have been promulgated in some parts of India, as to the cause of cholera being due *solely* to the state of the water-supply, were to take root."

It is most important that we should arrive at some definite conclusion as to the real nature of the disease, for it is impossible but that our conceptions on this subject must influence the sanitary measures that deal with it, and I believe the question must find its final solution in India, where the disease is always present in its endemic and seldom absent from the epidemic areas. The highest authorities—for both I have the greatest respect—differ *toto cœlo* on this subject. Is it that they are both right, though seemingly so opposed in their views? Like the knights who fought about the silver and golden sides of the shield, will they not change places and find why they differed?

I would venture to suggest that in India the inquiry might be pushed with more detail in regard to individual cases and outbreaks in certain limited areas; and that, on the other hand, one or more epidemiologists of European fame should be deputed to visit India and study cholera with the eminent men who have devoted so many years of close attention to it there. It might be, I believe it would be, that mutually they would gain from each other, and that those who went out would find their own views confirmed as to the disease in Europe—modified as to what they deemed it to be in India. Of one thing I am convinced, that simple truth is the object of their search; and I feel sure that from such combined action the greatest benefit would result.

I must now bring these remarks to a conclusion. I have made them purposely of a very general character, as I wished rather to indicate some of the subjects that we may profitably discuss, than deal with them in a controversial manner. I should like to have spoken of other epidemics—fevers, small-pox, the exanthemata and other miasmatic or zymotic diseases; of diarrhœa, dysentery, influenza, diphtheria, which all interest us as epidemiologists, and of those peculiar indigenous and endemic diseases such as leprosy, elephantiasis, beri-beri, and a host of cachetic conditions generally attributed to malaria, but perhaps susceptible of other explanations; of the interesting discoveries of Lewis, Bancroft, Manson, and others which have revealed to us the existence of parasites infecting the blood and tissues of men and animals to an extent hitherto undreamt of, probably having important causal relations with some of the endemic diseases hitherto referred to other causes, and on which I have already had the honour of addressing you. But time does not permit me to do so, for I have already detained you too long, and I can merely refer to them as subjects that I hope may from time to time occupy the attention of the Society. It only remains for me to thank you for the patient attention with which you have listened to me for so long.

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INAUGURAL ADDRESS
TO THE
EPIDEMIOLOGICAL SOCIETY.

Delivered on November 3, 1880.

By Surgeon-General SIR JOSEPH FAYRER,
K.C.S.I., M.D., LL.D., F.R.S., Q.H.P.

BEFORE we proceed to the regular business of the first meeting of our thirty-first session, it seems right that I should make a few preliminary remarks on the actual condition of the Society, and on the work that it has done during the past year. But let me first thank you for reappointing me to the office of President, and repeat that I shall endeavour to discharge as efficiently as possible the duties of the trust you have been pleased again to repose in me.

I am happy to congratulate you on the continued prosperity of the Society, and on the results of its working during the past session. The increase in number of members, the substantial addition to the funds, and the character of the subjects that have been discussed, are such as may, I think, give cause for satisfaction both as to our present and future prospects. The Epidemiological Society ought to exercise a wide and beneficial influence on the important questions regarding the origin and diffusion of disease that are constantly presenting themselves for consideration, and I believe we have grounds for hoping that this expectation is in some measure realised, and that its influence *is* gradually growing and becoming more widely diffused, as I hope to show by a brief reference to the subjects that have been discussed, especially those which have given opportunity of comparing certain diseases in tropical climates with the same diseases as they present themselves here. Let us hope that, as in former years it did in respect of small-pox and vaccination, so it may in future exercise its influence in regard to other questions concerning public health and the investigation of matters that are still the subjects of uncertainty in epidemiological science. It appears we have had an accession of twenty-three members during the past year, the great proportion being officers of the Navy, Army, and Indian Medical Departments; only six were unconnected with the public services. Whilst fully recognising the advantage arising from the co-operation of those who have had opportunities of studying disease on a large scale and under varying conditions in different quarters of the globe, I must say—and I think you will agree with me—that we should be glad if our ranks were more largely recruited from the profession generally, and also from other sources. Our Society is essentially catholic in its aims, and its object is the study of epidemiology on the broadest general principles, and under all conditions in which disease appears. It seeks information from medical men or others, whether in the public services, colonies or other foreign countries, or among the large

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body of physicians and surgeons, as well as other educated persons, who are scattered over the cities, towns, villages, and rural districts of our own islands, and who are all now more or less occupied, or if not occupied, are interested, in the prevention of disease and conservation of health. Therefore, whilst trusting that we may still continue to be supported as much as ever by the medical officers of the public services, I venture to hope that we may have large additions of those who have adopted the private practice of the profession; and I would add that the Society by no means desires to restrict its privileges to medical men, but would gladly associate with it military and naval officers, sanitary engineers, architects, and members of other cognate scientific professions, as well as magistrates or administrative officers, especially those who in our foreign possessions have public duties that bring them in contact with questions bearing on public health. Among the numerous scientific societies in London having claims on medical men, the Epidemiological, I fear, offers comparatively few attractions to the profession generally—concerning itself with questions that are chiefly of general, rather than special, interest. It commends itself, naturally, to the medical officers of the public services, dealing as it does with subjects that have occupied so large a share of their attention, but perhaps fails to interest the younger and working class of medical men who are intent on special subjects of inquiry. But I hold that this Society should include on its rolls *all* classes of the profession, as well as other scientific men, as the questions that fall under its consideration are of interest to everyone, and I hope that, as time advances, it *will* attract such a share of attention as may place it in the position to which I think it is entitled.

The annual report informs us that our financial position, though not one of affluence, is at least fairly good. We have been able, after the payment of all expenses, and after publishing Part 2, vol. iv. of the *Transactions*, to show a balance at credit at the end of the session; and it is now intended to commence a new series of *Transactions*. We have also printed three papers on Fever in Sub-tropical Latitudes, to appear in a future number. And here we ought again to express our thanks to the authorities of University College for allowing us to hold our meetings in their Council-room, free of expense except such as attends the lighting of the rooms. It has, indeed, been questioned whether it might not be expedient to resort to the room in Chandos-street formerly occupied by the Society, and probably the subject may be re-opened at some future period; meanwhile the Council have deemed it better to remain where we are, so we shall continue, for a time at all events, to avail ourselves of the hospitality so graciously extended to us, and for which we make grateful acknowledgment.

So far, all I have had to say speaks of prosperity and progress—increasing numbers, interesting communications, and financial improvement. I have still to refer to the work of the past session; but, before doing so, I have another duty to perform. It has been with us as with others—time has brought loss as well as gain; and I have now to remind you of losses too grievous to be repaired, for we miss from among our comparatively limited number three men of great distinction, removed while yet in the vigour of intellectual life—one at a comparatively early age, just when the promise of his early years was being fulfilled. The past year told heavily on most of our scientific societies, and many an

honoured name has disappeared from their rolls; but I doubt if any have suffered, in proportion to their numbers, so much as we have, in the loss of Dr. E. C. Seaton, Mr. H. Leach, and Dr. E. Goodeve. Dr. Edward Cator Seaton was one of the founders and presidents of our Society, and it was during his early connexion with it that he commenced the researches into the subject of vaccination and small-pox which are embodied in his valuable reports, and ultimately led to that important measure, the Compulsory Vaccination Act of 1853. It is in connexion with this that his name has attained a wide reputation, for certainly no one has done more towards promoting the diffusion of Jenner's great discovery, and in systematising the methods by which it has been so largely extended to the people. His writings on vaccination and small-pox are well known as authoritative works on the subject, in regard to which his name will stand on record as that of a public benefactor. Dr. Seaton's public services were not confined to his efforts in respect of vaccination. As an inspector under the General Board of Health, he was much interested in, and actively concerned himself with, other sanitary subjects; and his selection as the British representative at the Sanitary Conference held at Vienna in 1874, of which he made a valuable report, bears witness to the esteem in which he was held as a sanitary authority. In 1876 he succeeded Mr. Simon, C.B., as Medical Officer to the Local Government Board, to which he had previously been Assistant Medical Officer. His extensive knowledge of sanitary science, his administrative capacity and sound judgment, made him a peculiarly fitting successor to his distinguished predecessor. Dr. Seaton enjoyed good health until a year or so after he became Medical Officer to the Local Government Board, when signs of impairment appeared. The duties, which were very arduous, had severely taxed his strength, but he continued to perform them for a year longer, when his medical adviser deemed it expedient to enjoin rest and change, which advice he prepared to follow. About this time a severe domestic affliction made a deep and profound impression on him, and must have aggravated the depression of his general health. He returned to work, however, in June, feeling anxious to resume duties in which he might find that solace which perhaps is the best remedy for such a sorrow. Some improvement in his health followed, but it was only transient, for in the following October, when on a visit in Warwickshire, he was seized with an attack of hemiplegia, from which he partially recovered, and hopes were entertained that his valuable life would be prolonged; but they proved illusory, for he sank under a second attack on January 21, 1880, in the sixty-fourth year of his age, deeply lamented by his family and by a large circle of friends. I had only recently made his acquaintance, but was, as others must have been, much attracted by his gentle and courteous manner and bearing; and felt that in him we had lost a sterling friend, the public a learned physician and sanitarian, and the Government a valuable officer,—would that I could have added that the public recognition to which his services eminently entitled him had been accorded! His valuable life closed too soon, but not too soon to have left an example which those who follow in the walk of life to which he devoted himself may feel pride in attempting to imitate.

It is also my duty to record the death of another distinguished member of the Society, Mr. Harry Leach, who died at the early age of forty-three, after a brief but brilliant career, which was largely devoted to the advancement of public interests, in the duties of the important office of Health Officer for the Port of London—a post of which he was the first incumbent, and which was founded, most probably, as the result of his own efforts during the cholera invasion of 1866, when he was most active, as a medical officer of the *Dreadnought,* in instituting a thorough examination of all ships that came into the river from suspected ports, and in devising measures for the relief and segregation of those who were attacked with the disease. He was enthusiastic in the pursuit of professional knowledge, and of all that threw light on the subject he had so much at heart, whilst his acquaintance with disease appears to have been sound and extensive. To his efforts and representations the merchant navy are largely indebted for measures that have tended materially to diminish scurvy, and they received their reward in the success that resulted from them, and in the passing of the Amended Merchant Seamen's Act, especially in regard to the use of anti-scorbutics. In his anxiety to benefit others, he took too little heed of his own health, and the fogs and damps of the river, to which he was much exposed in the performance of his duties, contributed to develope disease in lungs originally delicate. A voyage to Natal produced some improvement, but of brief duration, for he succumbed on November 26, 1879, to the great regret of all who knew him.

Since writing the above, intelligence has reached us of the death of Deputy Inspector-General E. Goodeve, M.B., Honorary Physician to the Queen, at Stoke Bishop, in the sixty-fourth year of his age. He had for some time been in failing health from some obscure form of cerebral disease, and the end came rather suddenly on the 27th of last month. He was at one time an active member of our Society, and took a prominent part in the discussions. His last public service was as British representative at the Cholera Conference at Constantinople in 1866. His knowledge of disease was profound, and his contributions on cholera, diarrhœa, enteric fever in India, and the so-called red fever of Bengal, were most valuable. His service in India commenced in 1841, and his whole career—whether in the field during the Sutlej campaign, in the large civil station of Cawnpore, where he acquired great experience, or during his long connexion with the Medical College and Hospital in Calcutta as Professor of Medicine and senior Physician, President of the Faculty of Medicine, and Examiner in Medicine of the Calcutta University—was most distinguished. He rapidly attained the highest honours and position as a physician and a teacher; whilst his retiring, unaffected, straightforward, and noble character endeared him to all who knew him. The medical officers of India have not been among the least of her benefactors; and none assuredly ever did more to deserve that epithet than Edward Goodeve. His death will be deeply lamented and his memory fondly cherished by his Service and by natives and Europeans alike in India.

I now turn to a brief retrospect of the subjects that have occupied us during the last session. They have all been important, whilst the discussions on them have been most interesting, especially those on Indian fevers, and I trust they may have the effect of drawing attention to the importance of reconsidering the question, especially as respects the etiology of those forms which, while presenting the

phenomena of the enteric fevers of Europe, are by some considered to be due to general rather than to specific causes. I will briefly refer to the papers that have been read during the past year. Three important contributions on Plague have been made: the first was by Dr. Payne, one of the two Commissioners appointed by Government in 1879 to investigate the plague which had been prevailing on the banks of the Volga in the province of Astrakan in 1878-79. This interesting communication threw much light on the geographical distribution, history, progress, and diffusion of the disease, which the Commissioners consider was Levantine plague; and on the measures taken by the Russian Government for its suppression. They consider that there is no evidence to support the theory that it was introduced by Cossacks returning from the war in Asia, or that it was directly transferred from Resht or elsewhere on the Caspian Sea to Vetljanka; but that everything pointed to the conclusion that the disease had already gained a footing in the district (whether introduced from outside, or springing up spontaneously in its soil) before the outbreak at Vetljanka. Dr. Payne remarks that, with regard to the possible spontaneous origin, "it appears that the same reasons which will hold to show that plague is endemic, or springs up without being introduced from elsewhere, in other parts of the world, seem to apply here. Actual proof of such an origin would be, almost in any case, unattainable; but the difficulties which beset all theories accounting for its introduction into the district certainly argue strongly in favour of such a view." With regard to the nature of the epidemic, its character, and its morbid anatomy, the wide spread of the disease, with special reference to personal communication and the influence of local causes of contagion, the Commissioners had no opportunity of forming any opinion from personal observations, as the disease had died out before their arrival. The information they obtained, from those examined on the spot, is all they had on which to form conclusions on these subjects, and it is to be regretted that, on matters about which wide differences have been expressed, the opportunity had not been afforded to such highly qualified observers of making personal investigation.

An interesting summary of the German Medical Commissioners' report on the same subject was read by Mr. H. L. Hamilton. Dr. A. Hirsch, of Berlin, whose account of the plague in Astrakan differs considerably from that of Drs. Payne and Colvill, describes it as a malignant contagious disease, with all the characters of Oriental plague, sometimes with buboes, sometimes without them. He and his German colleagues attribute the outbreak to the importation of infected articles from the Asiatic seat of the Russo-Turkish war, and that it was not imported from Resht; neither is it indigenous to Astrakan, where it had not appeared since 1808. Thus a further proof is afforded of the difficulty of tracing out the origin of this disease. The report shows that, owing to faulty and imperfect reports of the disease in Vetljanka, the Russian Government could not, or did not, avail itself of preventive or precautionary measures until the plague had attained its maximum intensity and was already approaching its natural termination. The paper was an interesting summary of the report, and showed that considerable difference of opinion exists on the subject of the etiology and mode of propagation of the disease.

Another interesting communication was by Surgeon-General Dr. Francis on the subject of Plague in India. He pointed out the geographical distribution in Kumaon and Gurhwal, to which it is at present confined, and where it is known as Mahamurrie, and described the characters and habits of the people of those districts, which are all conducive to the development of the disease. Known since 1823, but probably existing long before that period, it has been characterised by glandular swellings, hæmorrhages, and rapid death. It is endemic bubonic plague, caused by an animal poison which is generated by the operation of local conditions, and is in no way modified by malaria. Intensely contagious among the people themselves, the pilgrims and visitors who visit the shrines in that country, and those who carry merchandise to Tibet, appear not to suffer. Europeans also escape. The Pali plague—a disease having much the same characters, which was first known in the West of India in 1818—seems to be closely allied to the Mahamurrie, by which it has been, as it were, replaced, especially where insanitary conditions prevail, as they are so prone to do among those hill-people who claim Rajpoot descent. "It seems as though some common factors were at work, leading to the development of epidemic disease, each *sui generis* being brought out under the influence of certain local conditions. It is possible that the disease may have been imported through the medium of the cotton-workers, who may have received it through importation from Egypt *viâ* Surat in goods; but Dr. Francis is of opinion that the local conditions were sufficient to give rise to it, and that no assistance from without was needed. He attaches much importance to sanitary measures, and considers that it has been satisfactorily proved in the case of Mahamurrie that sanitary reform rigidly enforced was efficacious in presenting it."

These communications, though of considerable interest as contributions to the literature of the subject, do not add very materially to our knowledge on the important question of contagion and mode of diffusion and propagation. Let us hope that at no remote period it will again be brought under consideration.

Dr. Langstaff read a paper on the relationship between scarlatina, puerperal fever, erysipelas, and certain other diseases, in which he deduced, from the comparative death-rate curves and their annual fluctuations, that the different causes of death should be classified into the diarrhœal group, relating to the heat of summer; the bronchitic, to the cold of winter; and the scarlatinal group, and a provisional group comprising all the other causes of death not known to be much influenced by meteorological conditions. All this was represented in elaborate diagrams and curves. One object of the paper was to suggest the probability that the poisons of erysipelas and puerperal fever were identical, while diphtheria and croup were also due to but one poison, and to discourage the multiplication of species in the classification of disease. The paper was a valuable contribution to statistical medicine—a mode of studying disease which, pursued on an extended scale, enables the inquirer to arrive, by the numerical method, at the nature of the laws which regulate and govern the origin and diffusion of disease.

Cholera has not attracted so much of your attention as in former sessions, but it has not been overlooked, and a most practical paper by your late President, who has probably seen more of the disease than almost any living physician, occupied attention and discussion during the greater part of one meeting.

merely an epiphenomenon devoid of all causal relation to the disease. Dr. Chevers pointed out that though it has not appeared in Lower Bengal of late years, that country was subject to its ravages up to and beyond the end of the last century, and that it has appeared among the poor and half-starved inhabitants of certain districts and in the gaols. It has been considered by some that the outbreak of relapsing fever that appeared in Bombay in 1877 was not really referable to the famine that affected large areas of Southern India. The etiology of this form of fever, its relation to the effects of famine and to the spirillum, are still therefore *sub judice.* It is to be hoped that further research will produce reports that may give more light.

The chief interest of the proceedings of the year may be said to have centred in the discussion arising out of the communications by Drs. Ewart, Don, and C. Gordon, C.B., in respect of enteric fever. The subject has attracted a good deal of attention lately, in reference especially to the health of European troops serving in India and tropical climates. It is only recently, indeed, that the disease has been recognised as a cause of mortality in India, and now it appears from official reports that the death-rate from this disease among our European soldiers, especially the young ones, is very high. The question, therefore, that has been so earnestly discussed is this: Are all the cases returned as enteric fever, in which the symptoms and phenomena in life, and the post-mortem appearances, are similar to those of enteric fever in this country, due to the same causes?—that is, are they the result of the contagion of a specific poison generated in the intestine or its contents of one person, and conveyed to another through the intervention of air, water, or other medium? or are they not in some cases—perhaps a large proportion—due to causes of a different nature, referable to what are known as climatic influences, by which is meant heat, moisture, malaria, miasmata, or water in which these are dissolved or suspended, with perchance the addition of other causes (aërial, telluric) of which we know nothing positively, but of whose existence as dynamic agencies we probably have indications in other epidemic diseases. As to the existence in India and other tropical countries of a form of fever characterised by certain phenomena and pathological changes, very closely, if not exactly, resembling those that characterise the enteric fever of Stewart, Budd, Jenner, and Murchison, there is a pretty general consensus of opinion; and few who have practised long in India, or the tropics or subtropical regions, but have seen and treated cases that in all their symptoms and conditions were identical with the cases of typhoid they had seen at home. But on the question of causation there can be no doubt, as is evident from the papers referred to, that a considerable divergence of opinion exists, and, so far as I can make out from communications that I have seen or received from different parts of the world, it is a growing belief that the cause of some of the cases of the so-called enteric fever is to be sought in high temperature, malaria, miasmata, water contaminated by organic matter (not only fæcal), rather than in a specific poison generated in the intestine or in the alvine discharges after extrusion from the bowel; and perhaps in some state of body, especially in the young, that is induced by exposure to one or all of these, whereby the poison or cause of the fever is elaborated in the body itself. It cannot, I think, be disputed that the poison of the enteric contagion theory advocated by the high authority already referred to must be equally effective in producing fever

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wherever it occurs, and certainly not less so in India or the tropics than elsewhere. Few, I think, question its potency here now, though, if I may be pardoned for saying so, I think it is *possible* that twenty years hence, even here, this view may be somewhat modified. But, as I have said, some —and they are not inexperienced—are impressed with the belief that the specific contagion theory will not explain the facts in all cases abroad; nor do they see reason to think that a certain train of symptoms and phenomena during life, and lesions observed after death, must necessarily be *invariably* due to *one* single cause; but rather that the bowel ulceration, diarrhœa, spots, and a certain range of febrile disturbance in the temperature, and so on, may be brought about also by other conditions, such as those already referred to, and which make up what are known as climatic influences. It is, after all, a matter of speculation, and to a certain extent of evidence, for even in the most indisputable outbreaks of typhoid fever, wherever it may occur, the specific poison has never yet been seen or separated. Not that this is necessarily a reason for denying either its potency or the probability of its existence, on the one hand; but that, on the other, it seems equally reasonable to admit the possible efficiency of other causes.

For my own part, whilst freely admitting that enteric fever in India and the tropics may originate as it does here, I cannot resist the impression that other causes may be at work, and that cases of fever, which in India are not only called enteric, but present the phenomena in life and the changes after death that are characteristic of the disease in England, do occur, and not unfrequently, where it is more probable that climatic and other local conditions are the cause, than fæcal contagion; though it must be admitted that it is not possible to deny the possibility of a fæcal origin wherever human beings have been. But I have no desire to dogmatise, and I await further investigations and reports before I convince myself, or assert to others that to be a fact which at present is only an impression, though so strong as almost to amount to a conviction. It is a subject of considerable importance, and may well stimulate further inquiry, as there is reason to believe that it will, indeed has already, begun to receive, and nowhere with more interest than in this Society. I may not detain you to epitomise the three important papers, but would briefly say that in them the subject has been ventilated and discussed by men of large experience, who have had ample opportunity of forming opinions from *personal* observation; and the very fact that such observers differ in their views as to the etiology of this fever proves to my mind that there is good reason to think that the whole subject of the etiology of Indian fevers does need further consideration. Nor is this a matter of mere pathological or nosological interest, important as that aspect of the question may be, for it involves grave questions of sanitation, and it may be the expenditure of large sums of money in regard to the methods of dealing with the health of the European soldier or others generally in these countries, as well as the treatment. It is obvious that it is very important to trace out the causes and deal with them accordingly, and this I trust the discussions of our Society will in some measure tend to effect.

I must apologise for occupying your time so long, but the interest of the subject will, I trust, be sufficient excuse for what is but a brief commentary on a subject of much importance. We will now pass on to the first subject of the session.

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March 12th, 1883.

INTRODUCTORY ADDRESS
to the Medical Society

By the President,

Sir Joseph Fayrer, K.C.S.I., M.D., F.R.S.

Gentlemen,—I think it would hardly be possible for any one who had studied the past history and traditions of this the most ancient medical society in London—now commencing the 111th year of its existence—or who was at all familiar with the long roll of names of distinguished men who, as presidents, have directed its progress until it has attained the high position which it now occupies—to contemplate the prospect of seeing his own name added to that list, without feeling—however much he might be gratified by the distinction—some misgiving as to the wisdom of the choice, and as to his own fitness for an office of such grave responsibility. This indeed is my case, and all I can say, in acknowledging the great honour you have conferred on me, is that, in deference to your wishes, having accepted an office for which personally I feel that I have small claim and less aptitude, I will endeavour to justify your election, and try at least to deserve, if I may not command, success. I cannot call myself altogether a stranger here, for I have received at your hands signal proof that you have not so regarded me; but am well aware that, coming among you as I did but ten years ago at a comparatively late period of life, I am after all but a junior member, and am sensible that my opportunities of serving the Society—albeit you have permitted me to fill certain of its offices—have been neither so frequent nor so favorable as I could have wished, though I claim, in common with the oldest members, a thorough appreciation of its utility, a deep interest in, and a sincere desire for, the promotion of its prosperity. It was the first society into which I was admitted when I returned after long absence in the East, and to it my first contribution, in the form of a paper on some subject connected with disease, was made. I shall not readily forget the kindness with which I was received, nor the encouragement I derived from the courteous interest evinced by those to whom I had the privilege of speaking. Let me thank you heartily for all this, and for the confidence you have placed in me.

To one, trained and accustomed as I had been during a long pro-

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fessional life, to deal with disease, accident, or emergency in every form in which they present themselves to a military medical officer, especially to a member of that service in India, where of necessity speciality is unknown, and where whatever comes within the legitimate domain of physic, as well as much that lies outside it, or appertains to other departments of science,—falls within the sphere of his duties,—a society constituted as this is of representatives of every department into which the division of labour rendered necessary by the exigencies of a great metropolitan population has ordered and arranged our profession of medicine, whether as physician, surgeon, or member of that large and important class who, in general practice, are *κατ' εξοχην* the medical men of our country, commended itself to my warmest sympathy; and I have had no reason to modify the opinion I then formed of it; for not only have I heard many varied and important subjects discussed, but can honestly say that I have never left one of the meetings without carrying away some useful addition to such knowledge as I already possessed.

The friendly sociable spirit in which the work is carried on, and the keen, practical, yet always unacrimonious character of the discussions have impressed me, and many others, with a high sense of the utility, value, and importance of the proceedings. I can but tender my assurance that, as far as lies in my power, I will do my best to maintain the same desirable mode of procedure at our meetings, and trust, with your aid, in due time, to hand over the office to my successor, with the Society in a no less prosperous condition than that in which I received it from the accomplished surgeon, to whose courteous, able, and discriminating discharge of his presidential duties I venture to pay a tribute of respectful admiration, feeling, at the same time, very conscious how difficult I shall find it to fill the place he has vacated; and, gentlemen, let me remind you that even his efforts could only have availed when supported by you, and that I am no less dependent than he was on your countenance and encouragement. About this, however, I feel but little anxiety, for I know that these have always been freely accorded. Let me then only trust that you will be as generous and forbearing to me as you have been to my predecessor, and that you will overlook the shortcomings which are inevitable in one imperfectly qualified as I am for the duties of the office which you have called on me to perform.

Fortunately for you and me, this is not an occasion on which to inflict on you a long address; but as it is the custom for a new President to inaugurate the tenure of his office by a few introductory remarks I shall venture to occupy your time for a few minutes; but will make my remarks brief and quite of a general character, for there is other and much more important matter for you to consider this evening.

First, let me congratulate you on the prosperous state of the Society; which now numbers 420 Fellows, being an increase of 54 in the last five years, the unprecedented number of 47 Fellows having been added during the past twelve months; each year in fact showing that the list is increasing.

The financial condition, though we do not abound in wealth, is satisfactory. The Treasurer is able to show a satisfactory balance in hand (of over £200).

As you are doubtless aware, important changes are being made in the internal arrangement of our premises. A new and larger meeting room and library are being constructed; and there is good reason to hope that these, with a new lavatory, and other conveniences, and new Registrar's apartments, will be ready for occupation by the time we reassemble in October next. Let us hope that many interesting papers and discussions in the new meeting room, and many valuable additions to the shelves of the new library will signalise the year in which they are inaugurated.

These important changes, as you will understand, have trenched heavily on the funds of the Society, and will involve an outlay of about £4000. But you will be gratified to learn that an old and valued friend and former President has, with the munificence which has made his name familiar as a household word, come forward to our aid in a most generous and liberal manner, for which the Society, like many other institutions which have a philanthropic object, owe him much gratitude. It will also be satisfactory to you to be assured that the pecuniary liability is covered by a mortgage on the sixty years' lease already promised on completion of the premises, and that the rents from subletting will more than cover interest and rent.

The object of this Society, if I understand it rightly, is of a very catholic character. It is to collect, collate, compare and discuss matters of practical interest relating to any or all of the morbid conditions to which flesh is heir—it seeks to discover and make

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known whatever can aid in ameliorating or mitigating, when we cannot avert or cure disease, but is not less concerned with prevention than with treatment. Limiting itself to no speciality; medical, surgical, obstetrical, pathological, therapeutic, etiological, pyschological, or sanitary questions, all afford welcome subjects for discussion—the sole condition being that they shall be treated in a scientific and practical spirit, to the end that they may contribute to the good of man and the advancement of rational medicine. I ask you to continue to maintain and develop this high aim, and in this spirit to give as much time as you can spare to work which commends itself, not because it conduces to the benefit of individuals but to the good of all; for it is by comparing and discussing your varied views and experiences that hasty generalisations will be avoided and medicine will be advanced on a sound, rational, and scientific basis. The records abundantly prove that the Fellows of this Society have so dealt with it in the past, whilst the papers read and discussed during the last session bear ample testimony to the ever increasing energy and value of the work that is being done. I need only remind you of some of the papers of the session, for example, those by Mr. Mason, Dr. Stephen Mackenzie, Mr. Bryant, Mr. Pearce Gould (our new Secretary), Mr. Lund, Dr. Thorowgood, Mr. Gamgee, Dr. Richardson, Dr. Routh, Dr. Braxton Hicks, Dr. Symes Thompson, or the Lettsomian Lectures, to which I cannot refer without expressing admiration of the philosophical and masterly treatment of an important subject, which Dr. Sansom made clear and interesting as it was practical and original. No name among the Lettsomian lecturers will stand out more prominently than that of this learned physician to whom a well merited vote of thanks was so gracefully proposed and so cordially accorded. Gentlemen, I do not venture to dictate; but let me remind you how many subjects of great practical interest still wait further elucidation; and it seems to me that it especially behoves our Society to investigate and to see how far they may be made useful in our daily professional avocations, and be assimilated into medical practice.

Among such subjects, I may mention the very prominent question of the causal relations of minute organisms to disease. This has already engaged your attention on the occasions of the interesting papers and remarks of Drs. Whipham, Williams, Green, Heron, and others, and the beautiful demonstrations of Dr. Heneage Gibbes on

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the bacillus of tubercle, in which the relation of that microphyte to the disease was discussed. I hope it may again come before you, for it is unquestionably a subject of vital importance, not only as regards the etiology and propagation of tuberculosis, about which much still remains to be said, but because other diseases such as malarial fevers and even cholera are by some ascribed to a similar cause. Indeed it would almost appear as if all disease is to be associated with a micro-organism of some form, which, though by some regarded rather as an accessory or epiphenomenon, by others is held to be the very cause itself.

It is very satisfactory to know that many able observers are engaged in the investigation of a subject so momentous, and that not a few are Fellows of this Society. For my own part, fully recognising the importance of the discovery of these germs, and most earnestly advocating a patient and persistent prosecution of the study of their life-history, convinced that they play an important part in the etiology and genesis of many diseases, I think we are hardly yet in a position to say what that part is, and must admit that the true interpretation of the relations of these microbes to disease has yet to be determined.

Again, the cognate subject, considered in its surgical aspects, is of vast interest and importance.

The antiseptic method of treatment has revolutionised the practice of surgery. Surgeons from all parts of the world have borne testimony to its value, and to the fact that operations, formerly impossible, may now be done with impunity. Yet hardly has it become an established mode of practice, than its value (admitted by many even who decline to accept the rationale propounded by its distinguished advocate) is called in question, and doubts are thrown on it by men of high authority and experience, who declare it to be little better than a delusion, whilst they roundly assert that equally good results may be obtained without it, and that to care and cleanliness are due the benefits assigned to the antiseptic; by them the carbolic spray and the bacteria are alike rejected or ignored. Can we do nothing to decide such a question, and to ascertain the real state of the case? Of the facts there would seem to be little doubt, though the rationale of their production is disputed. Or turning to a field of work in which I have taken much interest, I might suggest for consideration such questions as those so ably dealt with by Lewis, Manson, Bancroft, Sonsino,

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Cobbold, Mackenzie, Harley, and others, in India, China, Australia, Egypt and other parts of Africa, as well as here and elsewhere, in regard to the parasitic origin of a group of diseases hitherto ascribed to other causes; or to the important question of the etiology of fevers, especially in tropical and subtropical climates, which is by no means conclusively settled there—I venture to question even if it be so *here*. Or the influence of climate, heat, malaria—whatever that may be—and of organic and inorganic miasmata, whether animal, vegetable, or gaseous, or of dynamic agencies operating through the nerve centres and vaso-motor apparatus, in producing certain diseases, or in influencing their propagation and diffusion; questions on the causation and diffusion of cholera, dysentery; questions in relation to hepatic disease, and to various forms of anæmia or cachexia, with their train of evil results to the nervous, vascular, and visceral arrangements, their dependance on climatic and malarial influences, which, with our ever extending communication with foreign countries, are daily becoming subjects of increasing interest, considering the numbers of persons who returning to this country affected by tropical disease in its chronic forms and sequelæ, must be constantly looking to you for relief from sufferings which change of climate alone has failed to effect.

Again, the true value of alcohol, whether therapeutic or dietetic, is still open to debate, and is a point on which a variety of opinions are held. Cannot more definite and settled views be arrived at on a subject of such vast importance about which reactionary opinions are largely influencing the whole nation? Or to turn to more specific matter, such for example as the histogenesis, pathology, treatment, and prognosis of morbid growths ranging from the simplest excrescence to the most flagrant carcinoma; how much has still to be learned, how many deeply interesting questions are to be answered. Many other subjects will suggest themselves to you affording fertile matter for consideration and discussion which does so much to extend and consolidate practical knowledge—that which avails us in the presence of actual disease, and gives confidence in diagnosis and reliance on treatment—which, after all, is the great object of our science and our art. Now I believe we are all quite alive to the importance of treating these matters in a practical way, whilst we fully recognise, at the same time, that the strictest principles of scientific induction should guide our reasoning in regard to them. But if there be a place in which the study of applied

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science is appropriate, that place is the Medical Society whose object is the prevention, diagnosis, and treatment of disease. Here let me suggest that our investigations need not necessarily be limited to rare, or what are commonly called *interesting* cases or pathological curiosities. There are cases apparently simple and at first sight of little interest, such as you might hesitate to bring before the Society, though they have puzzled even an experienced observer and remain to a great extent unexplained—cases occurring in the daily routine of professional experience about which discussion and comparison of notes would be of infinite value in clearing away doubts and ascertaining what others know about the matter. I invite you to bring such cases here, for out of them perhaps some important issue may arise by which light may be thrown, which may lead to practical deductions of greater value than the study of more abstruse pathological or therapeutical problems might afford. I could hardly illustrate what I mean better, than by referring you to the last paper read here, on the use of the cold douche in the treatment of what is unhappily not an uncommon form of disease. I think all will admit that Dr. Broadbent invested it with great interest, and made it very instructive.

Such, it appears to me, is the work that has been going on here for more than 100 years, and such I hope it will continue to be during the years to come, ever improving and extending as the circle of science is growing larger. I venture to hope that, with your help, our able secretaries will in due time produce fresh contributions to the literature of medicine in the biennial volumes of 'Transactions.' To these let us hope the younger Fellows will contribute of their rapidly advancing science; the seniors of that too, but also of their experience; for from these, and from the discussions they elicit, I know we may look forward to much that will be profitable wherever the 'Transactions' circulate and there are members of our profession to read them.

For my own part, I look forward with pleasure to the coming year, in hopeful anticipation that, with your support, we may do much good, and that I may be able to occupy this chair with benefit to the Society.

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Oct. 29. 1883.

OPENING ADDRESS.
to the Medical Society

By the President, Sir Joseph Fayrer, K.C.S.I., M.D., F.R.S.

Gentlemen,—Before we proceed to the regular business of this evening's meeting, I desire, with your permission, to make a few introductory remarks on the occasion of our assembling after the recess to resume the work of the 111th session of this ancient Society, which though venerable in years and experience is always, I trust, vigorous, energetic, and flourishing as its many and more youthful compeers. I am sure you will agree with me that the present is an eventful period in the annals of the Medical Society, and one of such importance as to merit special notice, and whilst reminding you of this I would invite you, at the commencement of a new and important era in its history, to determine to do all in your power to infuse new energy and life into its work, so that it may not only continue to maintain the high position it has so long enjoyed, but that it may still further advance, keeping pace with the progress of scientific and intellectual culture which characterise the age in which we live generally, and so eminently distinguishes the profession of medicine in particular, thus extending the sphere of its influence and utility, and vindicating its title to the high place to which from its traditions, its ancient renown, its present work, and its relation to other societies which have sprung from it, it is so justly entitled. It is needless to recount to you the various events which have marked the origin, rise, and progress of the Medical Society of London. You probably all know that it was founded by a physician of great eminence when George III was king, that it is the oldest medical society in the metropolis, that from it other societies have taken rise and have so prospered as well-nigh to outgrow and overshadow their parent; and that a long roll of names distinguished in various departments of medicine enumerates its presidents, lecturers, orators, and prizemen, whilst its 'Transactions' contain numerous contributions to medicine of the greatest value.

Dr. Routh, a former President, and Dr. Symes Thompson, a former Orator, have told us in their interesting addresses of the ups and downs, the vicissitudes and changes of fortune it has undergone; how it was amalgamated with other societies, and from time to time changed its local habitation, though not its name; how, from small beginnings in the east, it gradually grew and migrated to the west of London, always tending upwards to a higher standard of practical excellence and utility, until it finally settled in its present home, where, we trust, a renewed career of usefulness will follow the recent step in onward progress which was so happily inaugurated last July by the presence of H.R.H. the Prince of Wales, whose interest in the Society on that occasion was so warmly manifested and so graciously expressed. Now, all this has only been achieved by much labour and perseverance; and it is to the indomitable energy of the Fellows, the untiring labour and interest in its welfare which have been evinced by its officers, and to the firm determination of all concerned that the Society should prosper, that we owe the present happy position in which it is placed, and to which we turn with confidence as an augury of future success. And here, gentlemen, I am sure that I express the sentiments of the whole body of Fellows when I say how deeply we are indebted to our late President, our Council, Secretaries, Librarians, and Registrar, for all they have done, and for having secured for us the great advantages we now enjoy. It is for you to maintain the high prestige, scientific value, and practical utility of the Medical Society and to develope it to a further pitch of excellence that shall be commensurate with the aims of an institution which claims, in true catholicity of purpose, to represent the work of all branches or departments of medical science.

I am not going to weary you with a long address, and merely propose to occupy your attention for a brief space with a few observations germane to the present occasion and having reference to matters which concern the work of the session before us. I shall then make way for one to whom we shall all eagerly listen, for I am happy to think that our first meeting will be devoted to a subject which must be of deep interest when treated by the great surgeon who has already placed his name as high on the roll of benefactors of the human race as on that of men of science.

But let me first say a few words on the actual condition of the

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Society, which, I rejoice to think, is altogether satisfactory. The Fellows now number as follows:—Honorary Fellows 39, Corre- ponding 60, Ordinary 376, Non-subscribing 70, making a total of 545. Of these 47 Ordinary Fellows were added between October, 1882, and May, 1883, and 18 since then are candidates for admission. I trust we shall add largely to that list during the present year.

Our financial position is satisfactory; we certainly are not rich, but we *are* in a position that may be considered as encouraging. The official reports have given you details of receipts and expenditure, and you would learn from them that our disbursements on account of building, furniture, &c., have been heavy.

The Treasurer's report will have informed you how we have met, or are going to meet, the heavy demands accruing from the building of the new rooms, and you probably have heard how much we have been indebted to a late President, Sir E. Wilson, for his generous assistance in this respect. We must all regret that he is not here to see the changes which he has so liberally aided in effecting, and still more regret that ill-health has deprived us of his presence, whilst we express a hope that at no very distant period we may again welcome him among us.

So far, gentlemen, I have had to speak of prosperity and success. I must now turn to the reverse, for we have that also to consider. Still I am thankful to say that, considering our numbers, the proportion of losses by death is not numerically large, though very severe when measured by the value of some of those removed. We have to deplore the death of three of our Fellows, and in one case under circumstances of so sad a nature as greatly to enhance the grief felt for his loss by the Society, the profession generally, and by his own family and numerous friends. It is with peculiar sorrow that I refer to the death of an old and distinguished Fellow, Dr. R. Boyd, who lost his life in company with his son and three other persons when endeavouring to save the lives of others during the disastrous fire which, at one fell swoop, deprived his family of a much-loved father and brother (and of their valuable property), the profession of an able and accomplished physician, and many, of a much-loved and respected friend.

Dr. R. Boyd was an M.D. of Edinburgh, F.R.C.P. of London, and a Fellow of the Medical and other Societies. He had reached the mature age of seventy-five, but was full of physical and intel-

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lectual vigour. He had long been known and eminent as an alienist physician, and had contributed largely to physchological and pathological science; on these subjects his communications were numerous and valuable. At the time of his death he was superintendent and, I believe, proprietor of the Southall Park Asylum which, on the 14th August last, was totally destroyed by fire. It was in his efforts to save the lives of those committed to his care that he and his gallant son, Mr. W. B. Boyd, met with their deaths, and thus sadly though nobly terminated a life which had been devoted to good works. The Fellows of the Medical Society will join with me in an expression of deep sorrow for his loss and sympathy with his bereaved family and sorrowing friends, whose deep and lasting regret must, like ours, be mingled with admiration for the heroism with which he and his brave son gave up their lives in the attempt to save those of others.

Mr. Alfred Ebsworth, a Fellow of the Royal College of Surgeons, and Licentiate of the Apothecaries Society, and who resided in Henrietta Street, became a Fellow of the Society in 1864. He read a paper on nursing institutions before the Society, but does not appear to have been a very frequent attendant at the meetings. Probably his professional avocations left him little leisure for other work. From all I have been able to learn he was a man of much general information, and was well known among the brethren of the mason's craft.

Mr. William Field, of Kingsbury, Middlesex, who died during the past year, was one of the oldest Fellows of the Society, having been elected in 1847. He was not a frequent attendant at the meetings, and does not appear to have made any communications, but showed his interest in it by liberally contributing to the funds of the Society.

The last and not the least of the losses we have sustained, though happily not by death, is that of our Treasurer, Dr. A. Wiltshire, and in alluding to him I feel sure that I shall enlist your warm sympathy and concurrence when I express the deep regret we all feel for the serious illness which has deprived us of a much-esteemed colleague. He joined the Society in 1870, and has been one of its most active supporters. He has filled the office of Vice-President, Secretary, Councillor, Lettsomian Lecturer, and was Treasurer until a few weeks ago, when serious illness compelled him temporarily to resign that office. He had worked hard

and written many valuable papers for the journals and societies, on midwifery, on tetanus, delirium tremens, and other subjects, and was, I believe, engaged on a new book when attacked by the disease which has deprived us of his valuable services. It seems but the other day that he presented all the appearance of vigorous health and intellectual activity, and to have been struck down just at that period of life and of his professional career when his energy and merit had attained for him a position which promised the realisation of his natural ambition and the well-earned reward of his lifelong devotion to his work. You will all join with me in condolence and sympathy for his affliction, and in the hope that he may soon be restored to health, to the Society of which he was a brilliant ornament, and to the family and friends who are in anxiety on his account.

Let me now briefly refer to the work of the session before us. I congratulate the Society on the prospect of receiving many communications on subjects of practical interest from men of the greatest eminence in various departments of medicine. I have already in a short circular letter which I had the honour of addressing to the Fellows alluded to these, and it is needless for me to repeat what I then said, but I may just remark that I think we are especially fortunate in the selection of the subject with which our first meeting is to be occupied, and that the Society will have the opportunity of enriching its annals with a paper of great interest. As with all other original investigators, Sir Joseph Lister's doctrines on the antiseptic system have been subjected to much criticism and severe experimental test, and, like them also, on the one hand they have been received and adopted generally with enthusiasm, whilst on the other, by a few with doubt and even distrust. Of the validity of the theory by which the distinguished author of the antiseptic system, explains its good effects there may perhaps be question, but of the valuable character of its results there can be, I think, but one opinion. Time and experience may modify the explanation of the *modus operandi* and the nature of the details of its practical application, but they can hardly detract from the value of the system itself. I trust that Professor Lister's paper may deal with the subject; that it will be fully discussed; and that your views and experience with regard both to the theory and its practical working may be freely expressed, and also that Sir Joseph Lister will tell us not only the actual state of the question from his own point

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of view, but how far he may be disposed to modify any pre-existing views and any details of application which his more recent experience may have induced him to adopt. The list of papers in possession of our Secretaries certainly affords prospect of a most interesting session, for the subjects are especially suited to the Medical Society, which above all things desires to be practical, and I am happy to find that many of the promised communications come from Fellows or others who practise in different parts of the United Kingdom. Needless to add that I have no intention in saying this of appearing to undervalue those from our brethren in London. I mean that I am glad to find that our Society is sufficiently appreciated by non-resident Fellows and others at a distance to induce them to communicate to us their experience. I cannot now attempt to comment in detail on special papers in the programme, but I would merely say in anticipation that personally I look forward with unusual pleasure and prospect of profit to some of the subjects, and especially I would refer to one on "Cathetic Fever" by Sir A. Clark, and about which I have written not a little, as it will probably throw light on a subject that came much under my notice in India; and to that by Dr. S. Mackenzie on "Paroxysmal Hæmoglobinuria" which will be to me as to all most acceptable. And here, if I might be permitted to make a suggestion, it would be that the subject of the diagnostic and prognostic significance of albuminuria may be brought before this Society: it is one on which I think much of practical clinical value has yet to be said.

Among other communications one from Surgeon-General Sir Guyer Hunter (who has recently returned from Egypt), on the epidemic of cholera which has prevailed during the last six months in the delta of the Nile, promises to be of special interest. I am sure the Medical Society will join with me in congratulating this distinguished medical officer on his safe return from an arduous and difficult duty, which has been performed with the ability, judgment, and success which were to be expected from an officer whose high professional character and administrative capacity were so conspicuously manifested during the tenure of his high office as Surgeon-General of the Bombay Presidency.

Sir Guyer Hunter's paper no doubt will give us valuable information as to the origin and diffusion of cholera in Egypt, and, if I mistake not, will go far to controvert certain views which have been advanced thereon and add further proof, were any needed, of

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the futility of that incubus of commerce and international communication, *quarantine,* which still has so firm a hold on the belief of other European powers and which is still practised to the detriment alike of trade, of commerce, and of health.

The etiology of cholera is indeed a subject of vast interest in its practical bearing. To know the *vera causa* of any disease is of great importance, for it is not until we really have this knowledge that any really rational mode of dealing with its prevention can be postulated, and to ascertain it no effort in research should be spared. We are far from possessing that knowledge of it as yet in respect of cholera, and men of equal experience of the disease still differ totally as to the etiology. In dealing with it as sanitarians we are bound to act on ascertained facts and not on theories, and albeit we know much regarding the laws of its movement, I venture to think we are not yet in a position to declare that we have discovered either its real cause or the mode of its diffusion. It is satisfactory to know that the subject is occupying the attention of several great micro-pathologists at present, and let us hope that their efforts may meet with success.

Experience in India has certainly taught us that in the ordinary sense of the term cholera is not contagious, and has demonstrated the futility of all *quarantine measures.* Experience has also taught us the inestimable value of sanitation both in preventing its occurrence and limiting its propagation and diffusion, and there is no evidence to show that it has *ever* been conveyed to Egypt by ships during all the years that that have elapsed since the opening of the Suez Canal and the consequent continuous stream of traffic from Indian ports which are never free from the disease. And yet it has been attempted to show that the recent epidemic was so brought to Egypt until clear proof was demonstrated that such was not the case. I think it will be found that not the least valuable result of Dr. Hunter's mission is the light he has been able to throw on this aspect of the subject.

Happily, though different views are held both here and in India as to the etiology and the diffusion of cholera, all are agreed that quarantine is useless. According to those who hold the non-contagionist view, quarantine is as irrational as it is mischievous. Whilst those who believe in its transmissibility by human agency, in ships' cargoes, think quarantine is useless because it can never be practically and efficiently carried out. Our continental

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friends argue, being firmly impressed with the contagionist view, that there is reason logically why quarantine should be made more strict, and they look with disfavour on our substitutes of inspection and segregation of those who are affected. The subject is one of vast importance not only from its medical, or rather I should say epidemiological point of view, but also as a political and international question of interest, and any information that can bear practically on it is of value. But this is neither the time nor the occasion for dwelling on the subject, interesting though it be; and I shall not trespass on your indulgence further, or anticipate what Dr. Hunter may have to say in regard to it. It only remains for me to say that I am delighted to meet you all again; that I trust the session will be a very prosperous one, that the attendance will be numerous, the discussions vigorous and critical as usual, and that everything we may do will be for the advancement of medicine and the furtherance of all the best interests of our noble profession.

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EUROPEAN CHILD-LIFE

IN

BENGAL

BY

J. FAYRER, C.S.I., M.D., F.R.C.P.

BENGAL MEDICAL SERVICE.

Read before Medical Socty of London 1872.

LONDON

J. & A. CHURCHILL, NEW BURLINGTON STREET

1873

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EUROPEAN CHILD-LIFE IN BENGAL.

THE subject of infant European life and health in British India must always be one of considerable interest, especially now when that country is becoming so great a field for European enterprise; and it is one, therefore, upon which accurate information is most desirable. For where can we find a city, town, village or community—I might almost say family—in England in which some one does not look towards India with interest, or expect with anxiety the arrival of each weekly mail that may bring tidings of relatives or friends in the far East? And this interest is daily enlarging among all classes, not so much from the extension of our empire in the East, as on account of the impulse recently given to various industries and arts, and to the development of the almost boundless resources of that great peninsula, which is calling for and giving employment to all classes of our countrymen.

The European infant population is no doubt rapidly increasing in India, and all that concerns its life and health must therefore be of great social as well as sanitary interest. As the missionary, the schoolmaster, the railway, the telegraph, and the printing-press exercise their inevitable

influence on civilization and on the development of the intellectual no less than the physical resources of the more remote as well as of the more central parts of the empire, so is an ever-increasing tide of Europeans, by whose aid these ends are attained, attracted thereby; for although native agency and labour are, and always must be, mainly relied on, it is found that European supervision and skill are indispensable, and that their supply increases in proportion to the demand.

Matters have changed in respect of the condition of the Anglo-Saxon in India during the last quarter or half a century; or to date from an earlier period, one might say since the days when Europeans not in the covenanted service of the Honourable East India Company were looked upon and styled interlopers and adventurers, and were permitted to remain in the country only on sufferance, being at any time liable to expulsion.

The position of the European resident in India of those days was very different from that of his countryman now. In some respects, perhaps, he had greater, though in many he had certainly less, advantages than his successors. If he had the opportunity of gaining greater wealth, more power, prestige, and of leading a more luxurious life, his voyage to India was seldom accomplished by the long and tedious sea route round the Cape in less, often in more, than from four to six months. If on his arrival in the country he found himself placed, even in youth, in an office of considerable responsibility, dignity, or much emolument; and if his life were one of Oriental luxury (a condition, by the way, which is grievously over-rated), yet he was cut off from his family and friends, and his communications with them were so few and at such long intervals that he gradually became isolated from home and its influences as much in mind as in person; and it is no exaggeration to say that this expatria-

tion was not more conducive to his moral than to his physical welfare.

All this is altered now. He reaches India from England in three weeks; he goes, if he will, from Calcutta to Simla in as many days; or, if he can afford it and feel so inclined, he may take leave, and, having spent half of the time in China or England, can be back in India by the expiry of three months—in less time than it formerly took him to go from England to Calcutta. The moral and social atmosphere in which he lives has changed, as might be expected: he lives more under the influence of home interests and impressions, and in all respects his life is different from that of the Anglo-Indian of former days. He has weekly communication with home by letters, daily by telegraph; he has all the new books, periodicals, reviews, journals but little later than they are to be found in the reading rooms of remote parts of the United Kingdom. He has all that is new in art, science, and literature—the railway, the telegraph, the penny (anna) post, gas, ice, theatres, museums, social and scientific societies, opera, clubs, circulating libraries—all that he could have in England; not quite so good, perhaps, as in London, but still sufficient to make life in India as tolerable as heat, malaria, damp, mosquitoes, and the dread of cholera will permit.

It is seldom much good occurs without bringing in its train some evil; nor have we any exception here. The European class in India is no longer confined to the covenanted *employés* of former years. The so-called "adventurer" class has increased: and by this I do not mean the merchant, the planter, the tradesman; these, like their covenanted and un-covenanted service brethren, are well enough as a general rule provided for, and well-to-do—free from the "*res angusta domi.*" I allude rather to the artisans, who are now numerous enough in India, on the railways, in factories, and

engaged in many subordinate offices formerly held by natives, and on whom and their families the necessities of life press hard enough in such a climate, and who have, in addition to the disadvantages natural to it, all the anxieties inseparable from the care of a family to contend with.

Among other improvements resulting from the spread of knowledge and the advance of science, those of a sanitary nature have not been of the least importance, for they are diminishing the death-rate and raising the standard of European health in India. I do not intend to refer to figures and statistics further than by a brief reference to the last report of the Sanitary Commission: those who care to study this question may do so by referring to the sanitary reports published by the Indian Government. Sufficient for the present to say that some improvement has taken place, and that European life is becoming more valuable than it used to be. I speak chiefly from the experience of military life—that is, of the British soldier—for so far as I know the only reliable health statistics are those relating to the sanitary condition of the army; but the principle applies to all, and among others, to the children.

Dr. Cunningham says, "It may be observed that the experience of the year 1871 has, on the whole, been favourable. In the case of Bengal this remark is peculiarly apt, for here in no year of which there is any accurate record has the mortality been so low. The death-rates in this Presidency for each year since 1858 are shown in the annexed statement, and the ratios for Madras and Bombay have also been included, so far as I have been able to obtain the required information.

Statement showing the Mortality per 1000 *of Average Strength among European Troops in the Three Presidencies during* 1871, *compared with that of each year since* 1858.

Years.	Bengal. *				Madras. †				Bombay. ‡			
	Cholera.	All other causes.		Total.	Cholera.	All other causes.		Total.	Cholera.	All other causes.		Total.
		In hospital.	Out of hospital.			In hospital.	Out of hospital.			In hospital.	Out of hospital.	
1858	9·16	91·39	10·52	111·07	§	..	..	..	§	..	..	..
1859	8·67	35·30	1·38	45·35	..	..	..	..	..	..	..	..
1860	12·04	24·14	·59	36·77	..	19·1	2·04	21·14	..	..	..	31·70
1861	23·73	21·06	1·14	45·93	..	14·5	1·8	16·3	..	..	..	24·72
1862	9·61	17·44	1·06	28·11	..	17·09	1·7	18·16	..	..	..	24·60
1863	4·09	18·85	1·18	24·12	..	16·5	3·01	19·51	..	..	..	16·14
1864	2·55	17·39	1·16	21·10	..	16·5	3·6	20·1	..	14·4	1·5	15·9
1865	3·12	20·40	·72	24·24	..	19·5	2·9	22·4	16·0	17·8	1·3	35·1
1866	1·37	17·34	1·40	20·11	2·3	17·9	1·5	21·7	0·6	10·7	1·4	12·7
1867	13·84	16·16	·95	30·95	0·36	15·34	2·3	18·0	5·0	12·4	1·9	19·3
1868	1·81	16·94	1·36	20·11	0·5	15·8	3·0	19·3	0·8	12·1	1·0	13·9
1869	16·46	24·98	1·45	42·89	2·2	18·8	2·3	23·3	5·2	13·7	2·5	21·4
1870	·63	19·74	1·53	21·90	3·5	13·4	2·3	19·2	0·1	15·3	1·3	16·7
1871	·71	16·07	1·05	17·83	3·32	15·40	1·38	20·10	·09	13·10	·83	14·02

"The death rate for Bengal in the past year—17·83 per 1000—although lower than it has ever been previously, is still above the ratio which has been attained in the other Presidencies, and specially in Bombay. The marked fluctuations in the Bengal mortality, chiefly due to cholera, contrast as a rule with the comparatively steady proportion of deaths in both Madras and Bombay."

* From Dr. Bryden's tables.

† From 1860-70, Sanitary Commissioner for Madras, Report for 1870, page 2; for 1871, Dr. Bryden.

‡ From 1860-63, Army Medical Reports; 1864-70, Report of Sanitary Commissioner, Bombay, for 1870; page 12, for 1871, Dr. Bryden.

§ The proportion of the deaths due to cholera in the Madras and Bombay Presidencies cannot be shown for the early years. The figures in these columns have been supplied by the Sanitary Commissioners.

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The death-rate of British troops in India in 1871 was only $17\frac{1}{3}$ per 1000; of officers 12·49 per 1000.

According to Dr. Townshend—

Mortality of Ten Years—1860-69.

	Max.	Min.	Mean.
Men	45·93	20·11	29·98
Women	68·03	25·46	43·31
Children	145·22	71·36	94·90

1870.

	Strength.	Deaths per 1000.
Men	33·373	21·90
Women	3·519	32·68
Children	5·644	81·68

Deaths of Children per 1000.

	England. Mean of 29 years. 1838 to 1866.	Bengal. Presidency. 1870.
Under 5 years ..	67·58	148·10
5 and under 10 years	8·80	17·73
10 „ 15 „	4·98	11·51

It has often been asked if the Anglo-Saxon can colonize India—*i.e.* can the race unsupported and unrecruited from home continue to reproduce itself and exist there? Can he, in short, do in India what he has done in America, Australia, —colonize or establish himself, take root, continue his race, people the country, and of course in so doing displace, or rather replace, the autochthones, and his older Aryan brethren, who have become acclimatized during an occupation of many centuries? I think not. But if I am asked, Why not? I must admit that I have no proof to give that it would be so, and that I have only my impressions to offer in support of the conviction, as the data for framing a precise reply do not, so far as I know, exist. I am not aware that the opportunity of testing the vitality and durability of the Anglo-Saxon race cut off from all communication with its own country or with the in-

digenous races has ever occurred; but I feel convinced that, had India been colonizable by the European, his position, important though it be, would have been very different to what it actually is. This, however, though a curious and important point of ethnic inquiry, is not the subject now to be discussed. I desire to consider, not the question whether the Anglo-Saxon can colonize India, but whether he can rear his children—the first generation—in that country, and with what prospect of success?

Sanitary science is doing much: life is being prolonged; health and the conditions of existence are altogether being improved. The European who becomes an item in the fixed population, who leads an ordinarily temperate and correct life, has expectations of life perhaps little below those he might have had in England. But still he is in a tropical or quasi-tropical climate, he is liable to certain grave and sudden disorders, he incurs a risk which has been variously estimated by life insurance societies, all implying greater danger to life than in England. This would be a question, also, of interest, and one that might furnish subject for profitable investigation.

But, as I have said, it is not of himself that I now wish to speak, but of his children, and especially of those whose parents are unable, from any cause, to send them to Europe for nurture and education. What are their chances of life and health, brought up and trained in India?

Now, with reference to the rearing of European children in India, much has been done during the last half-century. The necessity for proper schools, and establishments where not only their physical but their moral health would be regarded, has been the subject of serious thought, attention, and action of many good and great men in India, and has led to the establishment of schools and orphan asylums in

the Presidency and other towns and hill stations, which have contributed much to these good ends; and the various orphan asylums and schools in Calcutta—the Lawrence Asylum at Sanawar, and the Bishop's schools in the hill stations—will, as long as we remain in India, bring down with grateful remembrance to posterity the names of Claud Martin, Ellerton, Kidd, Sir H. Lawrence, Bishop Cotton, and others.

In these institutions the problem of infant health and progress in India is solved to a certain extent; but as a reply to the essential question I wish now to consider, that of European infant health, it is only partially satisfactory, for the reasons that, in the first place, some of the schools are situated in the hills, in an almost European climate; in the second, the children are to a great extent of mixed parentage.

The introduction of the indigenous race element of course entirely modifies the value of the information we thus receive. An opportunity, however, does exist in Calcutta of studying this very important question, and it would hardly be possible to imagine one better calculated to illustrate the subject.

In or about the year 1815 an asylum was founded in Calcutta for the female orphans of Europeans of the poorer classes in India, and the original reasons for it are set forth as follows in the annual report of the institution:—

"It has long been observed, by persons whose situations have enabled them to know the state of the children in the King's European regiments in this country, that those who become orphans at a very tender age, being usually left in the charge of careless nurses, and in many cases altogether unprovided with nurses, are very seldom reared to maturity, through the ignorance, indolence, and cruelty of those who

are entrusted with their management. An asylum, therefore, for the reception of such orphans would tend to the preservation of many lives which are now lost through the neglect or mismanagement of nurses, or the want of nursing altogether.

"1. This Asylum is established for the reception and education of female European orphans generally, but especially those of the King's regiments in India.

"2. Those children only are admissible whose fathers and mothers are both Europeans.

"3. The objects of this charity are admissible (if under 10) whenever they become orphans, at however early an age.

"4. That destitute children deprived either of one or both parents be eligible to the benefits of the institution, until the number reach to the amount of one hundred."

Originally intended for the orphan children of soldiers in the King's regiments (the only class of Europeans then in the country whose circumstances were so poor as to render it impossible for them to make provision for their children in case of death), it has of late years become of much wider application, for the class of Europeans who may require such a provision for their children is, and has been, as I have before said, increasing, and for many years a large proportion of its inmates have not been the children of soldiers—these being for the most part provided for by the Lawrence Asylum or other institutions founded of later years.

I would observe that this European Orphan Asylum differs from all the others in this respect, that it extends its benefits to children of pure Europeans only—any mixture of native blood rendering the child ineligible. The question of the growth, nurture, and vital statistics of the *Eurasian* child is one of great interest, but is apart from that with which I am now concerned.

It is this which gives it such value as a crucial test in studying the influence of climate in the growth and development of the European child, and is the reason why I have selected it as the basis on which the following remarks are made. The report on which these remarks are chiefly based commences in January, 1863, and is continued up to May, 1871, or for more than eight years, and also on the previous history for many years as related by the Secretary and confirmed by letters from Drs. Jackson and Webb.

It appears from these records that about 130 individuals have been under observation during this period, ranging in age from 1 year to 18 years—a daily average of about sixty-five girls. Say that in January, 1863, there were sixty-six in the institution; to these, before May, 1871, were added sixty-four, and of that number seventy had left. During this period there have been six deaths —one in 1863 from dysenteric diarrhœa, one in 1865 from mesenteric disease, one in 1866 after amputation, one in 1866 from convulsions in teething, one in 1868 from typhoid, and one in 1868 from atelectasis pulmonum.

It is remarkable how great an immunity these children have had, not only from the diseases peculiar to the country, but from all others of a severe kind. There has been during the period under report, and for many years previously, I believe, no cholera, no diphtheria, no scarlatina, no croup, no pleurisy, no pneumonia, no ophthalmia, no typhus, no phthisis, no severe malarious fever or its complications, no dengue, and no malarious cachexia. The diseases have been—a few cases of dysentery, one only fatal, in a child (a mistress died of that disease); a few cases of diarrhœa, simple fever, febricula; a few cases of typhoid (one death), slight rubeoloid,

slight hooping-cough; a few cases of modified small-pox—varicella; some catarrhal and bronchial affections; herpes, abscess, stomatitis, slight conjunctivitis, convulsions, simple sores.

SANITARY REPORT OF THE EUROPEAN FEMALE ORPHAN ASYLUM FOR SIX YEARS, COMMENCING JANUARY, 1863.

During this period the monthly average of each year of the number of girls in the school has been, in round numbers—In 1863, 68; in 1864, 70; in 1865, 67; in 1866, 66; in 1867, 59; in 1868, 60—being an average of 65. The ages vary from 1 to 18 years, the great proportion being between the ages of 5 and 16.

The sanitary history of this institution is as gratifying as it has been during previous years, and is not less remarkable for the absence of disease than for the generally vigorous state of health enjoyed by the inmates. The abstracts of admission into hospital show that there has been great immunity from epidemic disease of any severity, and the very low mortality, as well as the small amount of sickness, proves that the European child, under proper hygienic conditions and careful physical training, may live and thrive in the plains of Bengal *almost* as well as in its native country. It is not merely in the absence of any serious disease and the low death-rate that this is manifested, but in the vigorous, healthy appearance of the children generally. This was remarkably noticeable at the last yearly distribution of prizes, when the girls were assembled; and it is no exaggeration to say that their appearance on that occasion would have borne favourable comparison with that of the girls in any similar institution in Europe.

For this very satisfactory state of matters the thanks of

all interested in the institution are due to the careful and judicious management of the Ladies' Committee, who have supervised the institution, and especially to the lady superintendents, who have, under their directions, so vigilantly watched over the moral, mental, and physical education of their charges. It is impossible too highly to estimate the advantages of such management, and I am glad to have this opportunity of recording my impressions on the subject, and of declaring how much the high state of efficiency of the school, as well as the continued good health of its inmates, is due to the unwearied exertions and admirable administration of the past and present Lady Superintendents.

Disease during Six Years: Daily Average about Sixty-five Children.

Abscess	2	Icterus	2
Adenitis	2	Lumbrici	1
Œdema	2	Marasmus	2
Anæmia	1	Operatio	1
Aphthæ	1	Parulis	2
Bronchitis	1	Pleurodynia	1
Catarrh	24	Pneumonia	1
Cephalalgia	1	Rubeoloid	29
Conjunctivitis	5	Scabies	3
Convulsio	2	Sprained ankle	2
Curvature of spine	1	Stomatitis	3
Cynanche	3	Subluxatio	1
Debilitas	3	Torticollis	1
Diarrhœa	81	Tuberculosis	1
Dysenteria	15	Tumor	1
Dyspepsia	16	Ulcus	3
Febris (simp.)	77	Vaccinia	2
Febris (typhoid)	2	Varicella	4
Febricula	5	Varioloid	2
Furunculus	33	Vulnus capitis	2
Herpes	49	Vulnus digiti	1

There are several points of interest in the sanitary history of this school that might be considered, but I shall only advert to those which are most appropriate to this brief report. And first I would remark on the absence of any severe form of

epidemic disease. In looking over the monthly abstracts of admissions into hospital, I find that there has not been a single case of cholera; and that the only death from dysentery, which is the disease peculiarly to be dreaded in Calcutta, was that of ——, aged 5 years, which occurred in 1863, and this was rather a case of dysenteric diarrhœa in a naturally delicate child.

With reference to the class of disorders peculiar to early female life, I may say on this head that nothing could be more favourable, and that although there be certain indications of the influence of climate in either accelerating or modifying the usual functions, the state of health of the girls is, in this respect, most satisfactory.

The disease returned as measles was a rubeoloid fever of a mild form, slightly contagious, showing little tendency to spread, which has occurred from time to time, and has not been followed in any case by those grave sequelæ that so frequently result from measles in Europe.

Two cases of modified small-pox only are recorded, and there has never been any tendency in the disease to spread. The children have all been protected by vaccination, which has succeeded admirably in all upon whom it had not previously been tried.

A few cases of genuine typhoid or enteric fever have occurred, one of which proved fatal in 1868, the case of ———, aged 5. The other forms of fever have been of the simple continued form, or mild manifestations of the influence of malaria.

The same may be said of the cases of convulsions, a few of which have occurred.

Hooping-cough has been altogether absent.

A few cases of skin disease, but those of a simple and tractable kind, have occurred.

As might be expected among so large a number of children,

strumous disease has not been altogether absent, and one death from pyæmia in the Medical College Hospital after amputation of the thigh, the other thigh having been previously amputated a year before, for extensive disease of the knee-joint; and another from marasmus, the result of strumous disease of the mesenteric glands, have been recorded.

Of acute inflammatory disease, whether of the head, chest, or abdomen, there has been almost none.

Diseases of the liver or spleen, whether from malaria or other causes, have been also singularly few, if not altogether absent.

Pulmonary and bronchial complaints have been very few and slight; with the exception of one case of capillary bronchitis with atelectasis in a child aged fourteen months, who came in ill and died a week after admission; and a few slight catarrhal attacks involving the bronchial tubes,—none are recorded. Indeed the mildness of disease and the absence of those forms of it, with few exceptions, that characterize the Indian climate, have been remarkable.

The number of children under two years of age has been small, and therefore it is not to be expected that the diseases of first dentition should occupy a marked place; indeed, they have been almost altogether absent. The cases of convulsions recorded wer edue more probably to either centric irritation or the influence of malaria on the nerve-centres. But the evidences of malaria have been, on the whole, I am bound to say, very slight, as may be readily seen in the fresh colour and red lips of the children.

I would here remark, in proof of the improved sanitary condition of the girls, that lateral spinal curvature, of which ten years ago there were several cases, has now disappeared from the school. There can be no doubt that the very satisfactory state of health enjoyed by these children is mainly due to the sound hygienic arrangements, and the moral as

well as physical discipline under which they live. They inhabit a well-built, ventilated, and commodious house, surrounded by a large open space of garden or ground, in which they find amusement and healthy recreation in gardening, or play in the open air. The nature of their occupation is such as to conduce alike to their moral and physical well-being. They have sufficient mental labour to develope without fatiguing their intellects, and of a character suited to the sphere of life in which they are intended to live. With this is combined methodic occupation of a fitting character, regular hours, a good but plain and nutritious diet; and all that could tend to injure the health from constant or over-work of any special kind is strictly avoided.

The following statement of their daily occupations, diet, and recreation by the Lady Superintendent, explains how the time is passed; and it is a system that might well be followed by other educational establishments here and elsewhere.

Diet.—Three regular meals in the day, and bread early in the morning. Breakfast (half-past nine), bread and milk. Dinner (half-past two), meat every day for girls above twelve, and three times a week for those under; dhall and rice, etc.; fruit three days in the week. Supper (half-past seven), bread and milk. The milk is pure; no water with it.

Habits.—All through the year the children rise at five a.m., bathe in cold water, and then take exercise in the compound.

Occupation.—During the cold season school commences at seven, and in the hot weather at six a.m. Five hours of regular school, and one of study (preparing lessons) through the day. During the hours of recreation, skipping and active play are encouraged, and, as a rule, the children are as active and fond of a good romp as children in England. In-door exercise consists of cleaning the house, which is all done by the girls. Calisthenic exercises every morning.

The conditions of a healthy mind in a healthy body are here all existent, and the results show how materially a just combination of mental and physical training will, when supported by example in those whose duty it is to teach, conduce, even in the climate of Bengal, to ensure a high standard of moral and physical health.

In reference to the question of growth and development of the European child brought up and educated in Bengal, I may give the following illustration from the average measurements of five girls at sixteen years of age, which was—height, 5 feet 4½ inches; weight, 7 stone, 11 pounds; girth of chest, 34·7 inches; girth of hips, 35·7 inches—a stature and weight which would probably not be much exceeded in Europe.

During the next twenty-eight months—*i.e.*, from January, 1869, to May, 1871, the health of the school was excellent. Disease has been almost entirely absent; the general standard of health has been high. There has been no death. But two cases of any severity have occurred; one of pelvic abscess, from which, after an operation, the girl recovered, and is now in robust health; another had typhoid fever rather severely, but recovered. I would notice one or two causes, which are, no doubt, potential in preserving health, and have recently been introduced. First, the children now all wear flannel, and have a blanket at night under the sheet on which they sleep; and, secondly, they drink the new water from the stand-pipe. Both of these changes are beneficial. The absence of disease and the general good health that have prevailed is somewhat remarkable in a school of nearly seventy girls. In 1869 there was a slight outbreak of measles in January. Eight girls only were affected, and there were no unpleasant sequelæ. Except the two cases already alluded to, there was absolutely no other disease in this year. In 1870 there were a few cases of varicella; and in July, two cases of typhoid fever; both recovered. There was no other disease during 1870. Up to the date of the report

(May 6, 1871)*, there has been almost no sickness, with the exception of a few very slight cases of hooping-cough. The disease was clearly imported by one of the girls who had been out on leave. The cases are mild, and it shows no inclination to spread. Throughout the whole period there has been no small-pox; the children are all protected by vaccination.

The following table shows the ages at which each of twenty-seven girls commenced to menstruate. These girls are all of pure European lineage, such being a condition of their admission into the Asylum. It appears that seventeen were born in India, two in Ceylon, six in Europe, one in Australia, and one whose birth-place is not known. The earliest age at which the catamenia appeared was at 12 years and 2 months in a girl born in India; the latest at 16 years and 4 months in the case of a delicate strumous girl who died, after amputation (in the Medical College Hospital), of pyæmia; she was also born in India. The next latest was a girl born in England, in whom it commenced at 15 years and 8 months. Of the seventeen girls born in India, the catamenia commenced in two between 12 and 13; in five between 13 and 14; in eight between 14 and 15; in one between 15 and 16; and in one between 16 and 17. Of the six born in Europe, the catamenia commenced in one between 12 and 13; in one between 13 and 14; in two between 14 and 15; and in two between 15 and 16. Of the two born in Ceylon, it commenced in both between 13 and 14. One in Australia, between 15 and 16; and the one whose birth-place was unknown, between 12 and 13. Thus of the whole number—

Four	commenced	between	12 and 13	years of age.
Eight	,,	,,	13 and 14	,,
Nine	,,	,,	14 and 15	,,
Five	,,	,,	15 and 16	,,
One	,,	,,	16 and 17	,,

* This state continued until I left India in March, 1872.

Tabular Statement showing the Birth-place, Date of Birth, and Age at which the Catamenia first appeared in Twenty-seven Girls of European Lineage, educated and brought up (many born) in India.

Where born.	Date of birth.	Date of first menstruation.	Age.	Remarks.
India	March 3, 1851	March 13, 1864	13 years 10 days	Regular (left school).
India	October 20, 1850	April 1, 1864	13 years 5 months 11 days	Regular.
India	October 19, 1851	December 21, 1864	13 years 2 months 2 days	Irregular (left school).
India	September 28, 1848	February 10, 1865	16 years 4 months	Illness occurred twice (dead). Died March, 1867.
India	January 14, 1852	September 15, 1865	13 years 9 months	Regular.
India	July 27, 1854	October 10, 1866	12 years 2 months	Regular.
Ceylon	January 11, 1852	October 17, 1866	13 years 9 months	Regular.
England	November 11, 1852	December 3, 1866	14 years 19 days	Regular.
India	November 18, 1852	January 9, 1867	14 years 1 month	Regular.
India	April 23, 1853	January 12, 1867	13 years 9 months	Regular (left school).
India	June 9, 1852	March 27, 1867	14 years 10 months	Very irregular (left school).
England	June 18, 1852	November 5, 1867	15 years 5 months	Regular (left school).
Scotland	April 28, 1853	January 4, 1868	14 years 8 months	Regular.
India	January 7, 1853	December 28, 1867	15 years all but a week	Slightly irregular.
India	December 5, 1854	January 12, 1868	14 years 5 weeks	Regular.
India	August 12, 1852	February 1, 1868	15 years 5 months	Regular (left school).
England	May 15, 1854	March 8, 1868	13 years 10 months	Regular.
India	March 15, 1854	April 27, 1868	14 years 1 month	Regular.
Australia	August 10, 1853	September 28, 1868	15 years 1 month	Regular.
Ceylon	April 20, 1855	October 3, 1868	13 years 5 months	Regular.
India	May 5, 1854	October 11, 1868	14 years 5 months	Illness has occurred only once.
Not known ..	May 14, 1856	December 17, 1868	12 years 7 months	Regular and very profuse.
India	August 3, 1855	April 6, 1869	14 years 7 months	Regular.
India	May 25, 1856	February 6, 1869	12 years 8 months	Regular.
India	March 30, 1855	June 10, 1869	14 years 2 months	Regular.
England	December 21, 1856	June 12, 1869	12 years 5 months	Regular.
England	November 17, 1853	August 10, 1869	15 years 8 months	Regular.

The column of remarks in the table shows how the functions were performed subsequently. This is interesting as showing how far physical and moral training under favourable circumstances affect the European female child born and brought up in India.

I have been acquainted with these girls since they were young children, and the impression I have formed is, that they are rather more precocious both in physical and mental development than girls of the same age would be in Europe. They are most carefully educated, and, as the Report shows, their physical as well as moral training is most sedulously guarded from aught that could prejudice or injure either. But the stimulating effects of an almost tropical climate assert their influence; and it is evident that the girl of 16 or 17 is two or three years in advance of a girl of that age in a European climate. It is remarkable how few deviations have occurred from the natural and regular performance in the menstrual functions in these girls. As a rule it occurs regularly and without trouble, and it is most unusual to hear any complaint made on this score.

In connection, though perhaps remotely, with this subject, I would note the occasional occurrence among the girls of a swelling of the lower extremities evidently nearly allied to the elephantoid growth seen in the limbs of the natives of Bengal —a bucnemia. It is manifestly a steady and progressive enlargement about the ankle and leg, but extending slightly up the thigh itself, generally on only one side. If there be any change in the condition, it occurs at the menstrual period, when the limb is somewhat larger than at other times. The swelling is firm, not œdematous, and very like elephantiasis, except that it is not attended with either periodic pain or excitement in the parts, but is of very slow and steady growth. One of the finest girls (aged 17) in the school is affected by it, and the left ankle is more than an

inch greater in circumference than the right, and the swelling gradually extends to the left thigh, which is somewhat larger than the right. There is no pain and very little inconvenience, except that which comes from the increased size. I have not, as yet, succeeded in making any impression on it by medical treatment, and but very slight—only of a temporary nature—by bandaging. These cases, I am happy to say, are exceedingly rare, as during the twelve years that I have known the school, there have been only two or three; they are very interesting, and their pathology requires further investigation.

My personal knowledge of the institution ranges over a period of twelve years—*i.e.*, from 1860 to 1872,—and I have been, through the kindness of the Secretary, furnished with sufficient information as to the early history of the school to show that it has been equally satisfactory. The Secretary says, "I can't remember any sickly year with the above exception. I have known single cases of cholera, but none fatal; no outbreak of dysentery, but we have had single cases most years, but not fatal amongst the children. We lost two mistresses from death by dysentery, and one had to leave on account of that disease. I should say chronic dysentery, diarrhœa, and sluggish livers were the commonest ailments of the children. I never heard of diphtheria in the school. One of my earliest recollections of illness in the school was a very severe fever of the nature of typhus, I believe (which caused great anxiety), in a girl of 10, who became very delirious and lost her speech for weeks, but ultimately recovered, and no one else took the fever. My personal recollection of the European Female Orphan Asylum goes back to 1850. The only epidemic I remember besides measles and hooping-cough—one or other of which has visited the Asylum mildly every two or three years—was chicken-pock; in what year I can't

now recall, but it must have been pretty general through the school, for I remember the chapel was filled with beds as an additional hospital, and there was some anxiety, from the idea that it was modified small-pox, but no deaths occurred." The following letters from Dr. Webb and Dr. Jackson confirm this :—

Letter from Dr. Allan Webb to the Secretary of the European Female Orphan Asylum—1852.

"Having had medical charge of the European Female Orphan Asylum during the years 1849, 1850, and 1851, I have had abundant opportunity of judging of its general healthiness, and comparing it with other educational institutions for children in Calcutta. It must be, to all connected with this admirable institution, most gratifying to learn that the children are so healthy; that there is no institution in Calcutta surpassing it. I doubt if there be any in India more free from disease; and this happy result is attained—it must not be lost sight of—in children exclusively European in the climate of Bengal.

"But this testimony to the health of the girls generally is not limited to immunity from disease only, but comprehends that robust capacity for work and play which marks the well-being of a child. For this great blessing under Providence the children are indebted to the intimate personal supervision of the Lady Managers themselves in all that appertains to diet, exercise, and the neatness, cleanliness, and order which are inseparable from the salubrity of a girls' school; the fine open grounds and large airy upper-room dormitories being very important adjuncts.

"The school has not been exempt from disease. There

%/03

was a good deal of sickness in the earlier part of 1850, when small-pox and measles were raging in Calcutta, but the diseases were of a mild type in this institution; whilst of cholera I do not remember whether or not there was a single case, yet this is generally as common as it is fatal. The children were indeed wonderfully exempt from bowel complaints.

"I am, &c.,

(Signed) "Allan Webb, M.D.,

"Presidency Surgeon."

Letter from Dr. J. Jackson to the Secretary of the European Female Orphan Asylum—1853.

"I have great pleasure in sending you a short notice of the state of the health of the children in the Orphan Asylum during the last year, and it is a great satisfaction to be able to state that they have been altogether free from any of the ailments which commonly are observed in schools, and that during the whole of the past year, from the month of February, when I commenced my charge, there has scarcely been a sick child in hospital.

"This is attributable, no doubt, in some measure to the children all being of European extraction, but more especially is it due to the kind and judicious management which is bestowed upon them, to the regularity of habits, goodness of their diet, and the great attention paid to cleanliness and ventilation; and I consider it impossible to find an equal number of children in a better state, or more healthy condition, in any similar institution.

"I am, &c., (Signed) J. Jackson."

Reference to the later reports shows what is much to be regretted,—that notwithstanding its usefulness, this institution has rather fallen off in numbers of late years; that, whereas in 1853 there were eighty inmates, the number has decreased to sixty-five in 1872. Of course this is partly accounted for by the existence of other institutions; but, considering the increasing want and the advantages of this institution, it is matter of regret that there should be any falling off at all.

How much the value of infant life is affected by climate and the circumstances under which it is placed, may be seen by comparing the statistics of death of European children in England and soldiers' children in the Bengal Presidency, for which I am indebted to Dr. Townsend, Sanitary Commissioner of the Central Provinces of India, and by the statements which I have extracted from the last Indian paper (of March):—In 1871 there were nearly 11,000 soldiers' children in India, of whom 425, or about 5 per cent., were sick every day, while 794, or upwards of 7 per cent., died. The mortality, therefore, of children is thrice that of adults. Judging from the experience of 1871, the risk of life in the Bengal and Bombay Presidencies in each 100 European children is stated as follows:—thirty-three die under 6 months, twenty-two die between 6 months and 1 year, nineteen die between 1 year and 18 months, eleven die between 18 months and 2 years, two die between 2 years and 3 years, one and a-half die between 3 years and 4 years, and one between 4 years and 15 years. At this rate it is remarked, out of 100 babes, scarcely eleven would reach maturity.

For example in 1000:—

	England, the mean of twenty-nine years.	Bengal Presidency, 1870, by Report.
Under 5 years . . .	67·58	148·10
5 ,, to 10 . .	8·80	17·73
10 ,, to 15 . .	4·98	11·51

—or more than double. Now, that this mortality is due to some extent to preventible causes, and not only to climate, I think is tolerably clear, if compared with the death-rate of the European Female Orphan Asylum, where a similar class of children under better conditions gave such very different results. I am perfectly aware that statistics are only reliable in very large numbers, and that they have been said to be capable of proving almost anything; but I know that the life of the European children in barracks in India is not so safely guarded against evil as might be, and that, despite all the care and attention they receive, they are exposed to influences that tell more against life and health than is the case with children placed as those I have described in the European Female Orphan Asylum.

Miss Nightingale says justly, "Children are, as it is well known, the very touchstone—the live tests—of sanitary conditions, or sadly, but too often, the dying and dead tests of *insanitary* conditions."

That infant life and the preservation of health is peculiarly influenced by the hygienic conditions under which it exists, is proved by such facts as those I have narrated in reference to the European Female Orphan Asylum, and I would here remark that it has been shown to be equally so in England.

I am indebted to Mr. E. Chadwick, C.B., a sanitarian of European fame, for the following remarks on the subject in connection with the half-time school-drill review held on July 25, under the auspices of H.R.H. the Prince of Wales and the Society of Arts:—

"MORAL RESULTS.

"The great body of the children reviewed are orphans or deserted children. Under the old system of Poor-law

administration, the children of this class, brought up in the workhouse long-time school, in contact with aged and vicious paupers, were turned out at 13 or 14, bodily and mentally inapt for steady industry, and not above one out of three got into a place of self-supporting industry. Full 60 per cent. went to 'the bad,' on the streets as mendicants or thieves, the girls as low prostitutes, and they furnished the largest contingents to the population of the prison. These moral failures were attended by pecuniary waste, for all were supported by the ratepayers, either as mendicants or thieves, or as expensive prisoners. But now, under the improved mixed bodily and mental training of these half-time schools, the known failures and waste do not exceed 3 per cent. The great mass of the boys brought under review may be beheld with confident satisfaction as victims rescued from 'the bad,' and preserved for the good, as honest, self-supporting producers, and worthy members of the community. But although much of this success will be due to the bodily and industrial aptitudes imparted, and the work of the drill-master displayed, yet much of it will be due to the ministrations of the school chaplains, not alone in religious instruction, but in secular care and service, seeing that they get fitting places (especially girls), visiting them there, advising them, and corresponding, and acting *in loco parentis* to all the fatherless and the motherless.

"SANITARY RESULTS.

"It has been shown, as respects the common schools, where filthy-skinned and dirty-clothed children are often crowded together in ill-ventilated rooms, in miserable conditions, they are the common centres of children's epidemics. The old workhouse schools were subject to murderous epidemics. But now, by the application of rudimentary sanitary science, they are made normal examples of what

may be done by it. Of this, one of the schools from whence the children were sent to the first review may be cited as an example. Some years ago, the death-rate was 10 and 11 per 1,000. The drainage and ventilation were improved, and it was then brought down to about 8 in the 1,000. Next, more complete personal ablution and a swimming-bath were established, and the death-rate was reduced to about 4 in the 1,000. All the district schools, the elder of whose children will be reviewed, are to some extent children's hospitals, and many children are taken in only to die or linger as hapless cripples for life. But—with the exception of some remains of ophthalmia—by better ventilation of space, by careful skin-cleanliness, and by bodily exercise, the 'children's diseases of spontaneous origin may be said to be banished, and the death-rates have been reduced to about 3 in the 1,000, or less than one-third of the death-rates prevalent amongst children of the middle and well-to-do classes. With such a general death-rate, producible by sanitary science, there would be upwards of 10,000 children saved annually in the metropolis. Without such sanitary precautions, new schools may be only extended centres of children's epidemics.'"

I think it will be admitted that no more delicate test could have been afforded on the question of the state of infant European health, and the chances of life in the climate of the plains of India, than this almost continuous history of a little colony of about seventy European children—of all ages from one to eighteen years, educated and trained in Calcutta and never leaving the place—for a period of more than half a century. The answer it furnishes to the question is more favourable and satisfactory than might be imagined by those who have seen the evil effects of a tropical climate on infant life, for it shows that with care and attention much may be done that might be deemed impossible. The statistics of

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these children would, I know, compare favourably with those of any school in the world; and so far it is very satisfactory, for it demonstrates most clearly that with care and proper training a European child may live, grow, be educated, and even thrive in the plains of Bengal. This must be a consolation to those parents who are unable to meet the cost of sending their children to Europe, or even to the hills, and who otherwise must have the misery of feeling that their children were sacrificed to the inevitable hardship of having to remain in the plains. Having said so much, I have something to say on the other aspect of the question, for the matter requires careful consideration from both.

I have no desire to prove too much, as I certainly should appear to attempt to do were I to advocate the theory that Calcutta or any other part of the plains of India is a *desirable* locality for the training and nurture of European children; such, indeed, would be a theory as dangerous as false. For although the exceptionally favourable circumstances of the European Female Orphan Asylum prove that the European child may thrive, yet it is certain that without favouring influences it will not; and the statistics of infant life in the British Army in India, as I have also shown, prove not only that such is the case, but that the obstacles to success in the rearing of children are very great.

Moreover, the mere question of health up to a certain age, and the acquisition of knowledge, are not the only subjects requisite in the proper training of a child. It has long been known to the English in India that children may be kept in that country up to five, six, or seven years of age without any deterioration, physical or moral, and in the higher classes of life with probably as little, if not less, danger to life than in England; for most assuredly in some respects—as, for example, scarlatina, measles, hooping-cough, thoracic complaints, and even dentition,—they suffer less in India

than in England. But after that age, unless a few hot seasons spent in the hills should enable parents to keep their children in India until a somewhat later age, to do so is always a doubtful proceeding. The child must be sent to England, or it will deteriorate physically and morally—physically, because it will grow up slight, weedy, and delicate, over-precocious it may be, and with a general constitutional feebleness not perhaps so easily defined as recognised, a something expressed not only in appearance, but in the very intonation of the voice; morally, because he learns from his surroundings much that is undesirable, and has a tendency to become deceitful and vain, indisposed to study, and to a great extent unfitted to do so,—in short, with a general tendency to deterioration, which is much to be deprecated, and can only be avoided by removal to the more bracing and healthy (moral and physical) atmosphere of Europe.

Now, for many reasons, I think the notion is correct—that it is right that European children born in India should be brought up in Europe. But, as I have before remarked, as it must so often happen that the parents are unable to meet the cost of doing this, it is satisfactory to know that the climate of the plains of India is not of necessity fatal, as I think the history of the European Female Orphan Asylum incontestably proves, whilst it suggests the reflection how much more might be effected. I have no doubt that all that can be done in Calcutta under peculiarly favourable circumstances could be, and is, done better in the hill stations, and I have seen European children who have been born and brought up in these localities, who in physical health were not inferior to those who had been reared in Europe; and of such no doubt the numbers will continue to increase, for, as I have said, the Europeans who are unable to send their children home are becoming more numerous. Such schools, I am happy to say, are already existing, and their numbers will probably

extend, and I have no doubt will be much appreciated,—for the hill stations of India promise to become a permanent home to many of the class of planters, landowners, and even retired commissioned and non-commissioned officers. Such stations, notwithstanding their excellent climate, are, I think, too few and far between and too isolated to become the seats of real colonization; and though they may and will be the home of many Europeans, I believe they will never be such in a permanent sense.

I feel certain also that Europeans residing in India who wish to do full justice to their children, will, although it involve separation for years, continue to send them to Europe even in preference to the hills. But it is satisfactory to know that, for those to whom this is impossible, their children can be reared in the hills; and to others still more hindered by the pressure of impecuniosity than even in Calcutta or the plains, their children may with care grow up and become fitted for life in India—at all events for one generation. I have seen the third generation of Europeans in Calcutta born and brought up there. Such are rare, but examples are not wanting. Though neither in physical nor mental properties was there anything to suggest marked degeneration, yet there is that which would make one look with great doubt on the prospects of a race so produced.

It is a fact that some of the life assurance offices charge 10 per cent. more on the life of a European born and brought up in the plains of India. They attach the same value in fact to his life as to that of the Eurasian. It would be difficult, perhaps, to justify this on statistical grounds, but it shows, at least, how strong the feeling on the subject is in India; and I cannot help saying that generally I think they are right.

I have endeavoured to show by what I have said that although the mortality among European children in India

is, as a rule, very high, yet that under judicious management and proper hygienic conditions more favourable results may be obtained;—not that the European child can thrive and be reared as well as in the hill stations of India or in Europe, but that life and a very fair amount of health is possible even in Calcutta under *favourable circumstances*, and that as the numbers are increasing who must expect to bring up their children in India, they need not despair even though their lot be cast in Calcutta.

If anything I have said or could say had thrown a light on the subject, or would encourage those who have already done so much, and others who, with the power, are only wanting the opportunity of doing more in aiding in so good a cause as the protection of the child-life of their poorer fellow-countrymen whose lot has been cast in India, I should feel satisfied that this brief relation of my own experience on the subject has not been without result; and that it may stand as its own apology for these tedious details.

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RAINFALL AND CLIMATE

IN

INDIA.

BY

SIR JOSEPH FAYRER, K.C.S.I., M.D., F.R.S.

WITH A MAP.

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THE MAP.

The accompanying Map has been kindly prepared by the *Geographer to Her Majesty for India,* and is published by his permission: it is at once a map of the Physical Geography as well as of the Meteorology of India, coloured as regards the latter in accordance with the last published report of the Meteorological Department at Calcutta.

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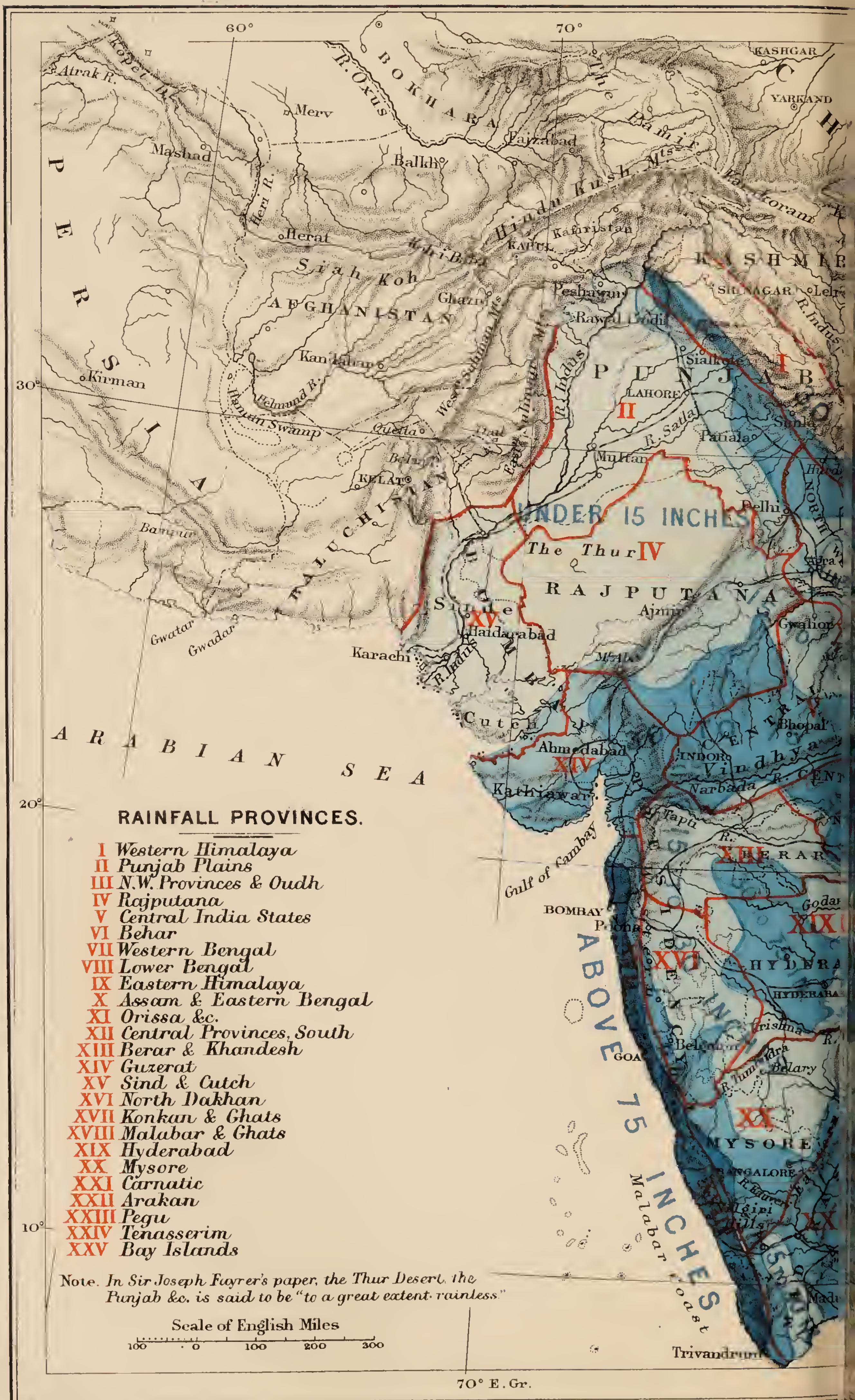
RAINFALL PROVINCES.
I Western Himalaya
II Punjab Plains
III N.W. Provinces & Oudh
IV Rajputana
V Central India States
VI Behar
VII Western Bengal
VIII Lower Bengal
IX Eastern Himalaya
X Assam & Eastern Bengal
XI Orissa &c.
XII Central Provinces, South
XIII Berar & Khandesh
XIV Guzerat
XV Sind & Cutch
XVI North Dakhan
XVII Konkan & Ghats
XVIII Malabar & Ghats
XIX Hyderabad
XX Mysore
XXI Carnatic
XXII Arakan
XXIII Pegu
XXIV Tenasserim
XXV Bay Islands
Note. In Sir Joseph Fayrer's paper, the Thur Desert, the Punjab &c. is said to be "to a great extent rainless."
Scale of English Miles
100 0 100 200 300
UNDER 15 INCHES
ABOVE 75 INCHES
ARABIAN SEA
PERSIA
AFGHANISTAN
BALUCHISTAN
BOKHARA
PUNJAB
RAJPUTANA
KASHMIR
The Thur
Sind
Cutch
Kathiawar
Gulf of Cambay
Malabar Coast
Karachi
Haidarabad
Ahmedabad
Bombay
Poona
Goa
Lahore
Multan
Peshawar
Kabul
Kandahar
Herat
Merv
Mashad
Kirman
Quetta
Kelat
Gwatar
Gwadar
Delhi
Agra
Ajmir
Gwalior
Bhopal
Indor
Bangalore
Trivandrum
Kashgar
Yarkand
Balkh
Faizabad
Hindu Kush Mts
Siah Koh
Vindhya
Narbada R.
Tapti R.
Berar
Hyderabad
Mysore
60°
70°
30°
20°
10°
70° E. Gr.

INDIA
THE RAINFALL IN 1880
According to the Meteorological Reporter to the Government of India;
combined with
THE HILLS & POLITICAL DIVISIONS
By Trelawny Saunders, Geog.r
Gobi or Shamo Desert
TIBET
EMPIRE
CHINA
L. Tengri
Manasarowar L.
LASSA
Brahmaputra R.
Sadiya
Batang
Kin-sha R.
Himalaya Mountains
Darjiling
Cherra Poonjee
Benares
LOWER PROVINCES
CALCUTTA
Dacca
Manipur
Bhamo
Momein
Ta-li-fu
YUN-NAN-FU
BURMAH
MANDALAY
Kiang-hung
Lan-tsang R.
Mouths of the Ganges
ABOVE 75 INCHES
Balasore
Cuttack
Akyab
Irawadi
Salwen R.
Prome
Pegu
RANGUN
Mulmein
Zimme
SIAM
Menam R.
BANKOK
C. Negrais
G. of Martaban
BAY OF BENGAL
Coromandel Co.
Andaman Islands
Mergui Archipelago
Malay Peninsula
Gulf of Siam
XXV
Nicobar Islands
CEYLON
VI
VII
VIII
IX
X
XII
XXIII
XXIV
90°
100°
30°
20°
10°
Stanford's Geog. Estab.t 55 Charing Cross.

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RAINFALL AND CLIMATE

IN

INDIA.

THE subject of this paper was suggested by one read here* on the 21st March last by Mr. Bateman in which he dealt chiefly with the rainfall of our own islands: in the course of his remarks he pointed out its importance in reference to the production of food, and the regulation of our own climate, which, as regards its peculiarly variable character, and notwithstanding its attendant drawbacks, is one of a combination of causes "which contribute largely to the fertility of the soil, the perseverance, hardihood, and energy of the people, and to the enjoyment of life."

* Before the Victoria Institute.

The author alluded to the meteorology of other countries, where the physical laws that regulate the production and distribution of rain are less subject to perturbation than in the northern latitude of our sea-girt islands, and referred to the benefit of a sufficient supply, and the evils that result from a deficiency of rain, as seen in some regions which are naturally almost rainless, or in others, which are in certain seasons the subject of drought.

In the discussion which followed, the remarks made in reference to the rainfall in other countries appeared to excite some interest; it therefore occurred to me that a brief account of this branch of meteorology in India—a country in which all are interested—might be acceptable as a supplement to Mr. Bateman's interesting paper, showing the results of excess or deficiency of rain, the operation of the meteorological laws that govern its distribution in tropical climates, and as affording opportunity for the further discussion of a subject which was far from being exhausted on that occasion.

As introductory to the meteorological question, let me say a few words on the geographical and physical features of that part of the world to which I am about to ask attention.

The physical peculiarities of a country have so much influence in determining the quantity, the distribution, and the periods of the rainfall, that it is expedient to take a brief general survey of them before considering details of the rainfall itself. It is necessary also to understand the conditions under which the atmospheric moisture originates, and the relations that the land and ocean bear to each other in respect of modifications of the air-currents and distribution of rain.

The subjects of climate and of meteorology are of great interest, and nowhere more so than in India; but, as even the most cursory glance at so comprehensive a matter would occupy more time than is allotted to a single communication, I must restrict my remarks chiefly to the rainfall, touching only incidentally on the climate and such other matters as may naturally be suggested by it.

A few words on the origin of rain. The gaseous envelope of nitrogen and oxygen by which our globe is surrounded, and which moves with it in its rotation and revolution, extends to a height or depth of forty to fifty miles in gradually decreasing density, where it may be considered, practically, to cease; though, doubtless, it extends further in an extremely attenuated form! This atmosphere is

permeated by another and no less important one of watery vapour, always present, though in varying quantities, according to circumstances of temperature, time, and place, derived from the ocean, the seas, lakes, pools, rivers, streams,—from the surface of the earth itself, and from all living things animal or vegetable. It is constantly rising and permeating the air up to the point where saturation is reached, or until it is condensed by cold, into the sensible form of dew, clouds or rain. On the varying conditions under which evaporation, on the one hand, and condensation on the other, take place, the rainfall depends.

The ocean is the great source whence atmospheric moisture is derived; it is the great bourne to which it all returns. As the wise king said,—"All the rivers run into the sea, yet the sea is not full; unto the place from whence the rivers come, thither they return again."

The atmosphere is the great sponge that soaks up and holds the watery vapour, which, when condensed, falls into the ocean, or on to the earth, to fill the rivers, to sink into the ground, whence it rises again in springs, collects in wells, lakes, and pools, or runs off in streams and rivers, diffusing itself everywhere, ministering to the wants of nature, and supporting life and organisation; finally, to return to the ocean, again to rise in vapour, and repeat the endless circulation, without which life would be extinct, and the earth reduced to the condition of the moon, or of some effete worn-out world.

Water is always evaporating; expose a cup of it to the air and it will soon disappear,—all the sooner if the air be dry and warm. So will ice or snow, in regions where the cold may prevent it from melting, but not from evaporating; it is not lost, but assumes the impalpable form of vapour, and mingles with the air. This process is going on wherever there is water, but more especially from that part of the ocean which, lying near the equator, is subjected to the continued heat of the vertical solar rays. Here vaporisation is most active, and the warm air, saturated with moisture, rising in constant currents to higher regions, is replaced by colder and heavier currents rushing in from towards the poles; in turn to be heated, charged with moisture, ascend, and so keep up a constant circulation, making the equatorial rain-belt the great distillery of nature.

The wind goeth towards the south, and turneth about unto the north; it whirleth about continually, and the wind returneth again according to its circuits." These perennial northern and southern currents, or trade winds, getting their

easterly direction from the earth's rotation, are always blowing towards the equator; whilst there is a regularity of climatic phenomena unknown beyond the tropics, where many and varied changes occur.

The northern hemisphere, containing much more land than the southern, is subject, on account of deflected ocean currents and "thermal" changes, resulting from the varying radiations of the land and sea, to greater perturbation of the conditions that determine the formation and distribution of aërial moisture, and other meteorological phenomena; and it is to one of the most remarkable of these, the monsoons of the Indian Ocean, that the climate and varying seasons of India owe much of their peculiar character.

Monsoons.

The great producers and distributors of rain in India, then are the monsoons or periodic seasonal winds. The term is of Arabic origin, from "Mausim," a season, and is applied to the great air-current that blows for one half of the year northwards, carrying the moisture taken up from a vast extent of the Indian Ocean, extending from Africa to Malacca; whilst for the other half of the year it blows from the opposite direction. The north-east monsoon corresponds to the north-east trade, and would be constant were it not for the counteracting influences which disturb the atmospheric equilibrium. Monsoons are not peculiar to India, but occur in other regions where there are similar distributions of land and water. The Indian monsoons are caused in the following manner:—About the commencement of April, when the whole surface of the continent of India becomes hotter than the sea, the rarified air rises, and is replaced by the comparatively cooler currents drawn in from, and laden with moisture taken up by evaporation from, the Indian Ocean. This is the south-west monsoon, which, rising to higher regions, or, being intercepted by the mountain ranges, condenses its moisture in rain on the Western Ghâts and on the coast of Aracan. Following a north-eastern course, it gradually loses its influence and its rain, as it approaches the northern limits of the continent. About October the winds are variable; there is a reversal of the current, which begins to blow southwards for the most part as a dry wind, till on the Coromandel coast it brings moisture from the Bay of Bengal, which falls as rain on the coast of the Carnatic and on the Eastern Ghâts; whilst some parts of the South of India receive a certain amount of rain with each monsoon.

This winter or north-east monsoon, which on land has a northerly or north-westerly direction, returns again as a south-westerly current in the upper regions of the atmosphere, having been heated in the south. It is sometimes called the anti-monsoon, appears to be felt in the Himalayas, and, descending in the North-West Provinces and Punjaub, brings their winter rains.

The rainfall on the southern and western coasts is the heaviest; but there are many variations and peculiarities due to local conditions; elevated regions receiving almost a deluge, whilst some lower areas are very dry. All the conditions favourable to the condensation and fall of rain exist in certain localities, whilst the converse obtains in others.

A few words on the geography and physical characters of the vast rainfall area we are about to consider. British India, the great central and southern promontory of Asia, situated between the eighth and thirty-fourth parallels of north latitude, and the sixty-sixth and ninety-fifth meridians of east longitude, includes also a portion of Afghanistan in the north-west, and part of the country on the eastern side ot the Bay of Bengal, extending from Chittagong to Tenasserim as far south as the tenth parallel of north latitude; it has a coast-line extending for more than 4,000 miles. It is about 1,900 miles in length from Peshawur to Cape Comorin; and about the same distance in breadth from Sudya,—a frontier post in Assam,—to Kurrachee at the mouth of the Indus; it is 900 miles from Bombay to Point Palmyra in Orissa. The superficial area is above 1,500,000 miles,—equal to the whole of Europe, excluding Russia; three-fifths being under British rule, are, therefore, with the exception of certain districts, under the observation of the Meteorological Department of Government. The geographical boundaries are well defined, on the north by the Himalayas, a chain of stupendous mountains (the highest in the world), 150 miles in average breadth, running north-west and south-east in a crescentic manner, in a double range, which is traversed by great rivers (Ganges, Sampu, Indus) running east and west for 600 miles; the valleys reaching to a depth that places their bases at not more than 6,000 to 10,000 feet, whilst its mean height is from 16,000 to 20,000 feet above the sea level, Mount Everest and Kinchinjunga, the loftiest peaks, being over 29,000 and 28,000 feet high. This barrier, which separates and isolates India from Turkistan and Tibet, is crossed by passes 17,000 feet above the sea, nearly on a level with the line of eternal snow. On the north-west it is bounded by the edge of the plateau of Afghanistan and Beloochistan, rising to the Suliman and Hala mountain

ranges, some of the peaks of the former reaching to a height of 11,000 feet; on the north-east, the heights of Assam, the Naga Hills, divide the drainage of the Brahmaputra from that of the Irawaddy. It is separated from Burmah and Siam by the Youmadong and other mountain chains, whilst its coasts have the Bay of Bengal on the east, and the Arabian Sea and Indian Ocean on the west and south, enclosing a table-land of from 1,500 to 3,000 feet above the sea level, between the Eastern and Western Ghâts; this table-land slopes gradually to the east, most of the rivers running to the Bay of Bengal. The mountains are separated into two distinct systems by a continuous low land extending from the Arabian Sea to the Bay of Bengal. This is washed by the streams of the Ganges and its tributaries on the east, by the Indus and its branches on the west. The western slope includes Scinde, the Punjaub, and part of Rajpootana; the eastern, which is divided from it by a water parting 900 feet above the sea level, contains the greater part of the North-west Provinces, Oude, and the lower provinces of Bengal. The north part of this lowland skirts the foot of the hills, and forms the damp region, called the Terai. The first or outer range of hills known as the Siwalik, and Salt Range, is about 2,000 feet high, whilst the valley separating these from the Himalayas is known as the Doon; the forest-clad base of the mountain range is known as the Bhabur. South of the lowlands of Hindostan is the triangular table-land of the Deccan, extending through 20° of latitude. Its base is the basins of the Indus and Ganges; its sides are the Eastern and Western Ghâts and the littorals of the Arabian Sea and Bay of Bengal, whilst the table-land seldom exceeds 2,000 to 3,000 feet high, and gradually slopes to the east. The Western Ghâts rise to 4,000 to 5,000 feet; Dodabetta, the southern peak in the Neilgherries, is 8,640 feet high. The Eastern Ghâts are not so high, and much less continuous than the Western. The whole of India forms two great watersheds; that of the Bay of Bengal on the east; that of the Arabian sea on the west. The former includes the whole of the peninsula east of the Aravulli hills and Western Ghâts; the latter, the basin of the Indus, Nerbudda, Tapti, and the declivity of the Western Ghâts. The water, parting, runs nearly vertically from Cashmere to Cape Comorin. This vast country, which has nearly two hundred and fifty millions of inhabitants, of races more ethnically distinct, and more numerous than those of Europe, has, owing to the nature of its physical geography and the extent of its area, every kind of climate, from that of the Torrid to the

Arctic zone; possessing lofty mountains, elevated table-lands, alluvial valleys, desert tracts, and plains; noble rivers, extensive swamps, jungles, and magnificent forests; it has characters that invest it with peculiar interest for the meteorologist; for, as Mr. Blanford says, "it offers peculiar advantages for the study of meteorology, exhibiting at opposite seasons of the year an almost complete reversal of the wind system and of the meteorological conditions depending on it. Its almost complete isolation in a meteorological point of view from the rest of the Asiatic continent by the great mountain chain along its northern border simplifies to a degree almost unknown elsewhere the conditions to be contrasted, by limiting them to those of the region itself and the seas around. India also presents in its different parts extreme modification of climate and geographical feature. In its hill stations it affords the means of gauging the condition of the atmosphere at permanent observatories up to a height of 8,000 feet. The periodical variations of temperature, vapour, tension, and pressure, both annual and diurnal, are strongly marked and regular; and these changes proceed so gradually that the concurrence and inter-dependence of these several phases can be traced out with precision." As regards climate, India may be divided into:—1. Himalayan, including Bhotan, Nepal, Gurhwal, Cashmere, and Cabul. 2. Hindostan, which extends along the foot of the Himalayan range, and includes the alluvial plains of the great rivers Ganges and Indus, with their numerous tributaries, as far south as the Vindyah mountains. 3. Southern India, or the Deccan, which consists of elevated table-lands, littoral plains intersected by numerous rivers, mountain ranges, and isolated hills. The Aravulli and Chittore hills, the Vindyah chain, rising to over 2,000 feet, covered with forest vegetation, with its off-set the Satpooras, traverse the continent connecting the Eastern and the Western Ghâts."

The rainfall varies according to latitude, elevation, and physical characters of the country, Northern India being less influenced than the Deccan by the south-west monsoon. The climates also vary; but in the plains of Hindoostan and the table-lands of the Deccan, the heat is intense, though often greatly modified by moisture. The effects of a dry or damp atmosphere at the same temperature, however, are very different. Dry air, in motion, at a temperature of 100°, is more tolerable than stagnant air loaded with moisture at 80°. The hot dry winds of Northern India are more endurable than the cooler but saturated atmosphere of Lower Bengal or parts of Southern India.

The *mean* temperature of a few well-known stations is as follows :—

Calcutta, 8 feet above sea level, is in May (hottest month) 89° ; in January, 70° ; but it ranges between 45° in the coldest and 92° in the hottest months.

Madras, sea level.—June (hottest), 88°; January, 76°. Range, 72° to 92°.

Bombay, sea level.—May (hottest), 86°; January, 74°. Range, moderate.

Peshawur, 1,056 feet above sea level.—June and July (hottest), 91° ; January, 52°. Range, great.

Punjab, 900 feet above sea level.—June (hottest), 89° ; January, 54°. Range, from frost to intense heat—110° and more.

Bangalore, 3,000 feet above sea level.—May (hottest), 81° ; January, 69°. Range, moderate.

Poonah, 1,089 feet above sea level.—May (hottest), 85° ; January, 70°.

Belgaum, 2,200 feet above sea level.—April (hottest), 81° ; May, 78° ; June, 75°. December (coldest), 70°.

The coldest months are December and January ; the hottest, April, May, and June.

There are fluctuations in temperature owing to hot, dry winds, sea and mountain breezes, great river basins, the presence of forests, tracts of jungle and vegetation, arid treeless rainless deserts, which give local peculiarities of climate ; but it may be said, generally, that there are three distinct seasons in India—the hot, the rainy, and the cold,—which vary in duration and times of setting in ; but approximately the cold season extends from November to March, the hot from March to June or July, and the rainy season from that to October or November, these seasons being greatly influenced by the monsoons. The south-west monsoon commences with storms of thunder and wind, which are soon followed by the bursting of the rain on the Malabar coast, in May, but reaches regions further north later in the year. Its force and influence, indeed, are well-nigh spent ere it passes the twenty-fifth parallel of north latitude. The Carnatic and Coromandel coasts, being sheltered by the Western Ghâts, are exempt, when the west coast is deluged with rain.

About Delhi and in the north-west the rains begin towards the end of June, and fall in diminished quantity. In the Punjab, near the hills, the rainfall again increases ; but in the Southern Punjab, and in the Great Desert regions, there is very little rain,—in some parts none. There are belts or tracts of country commencing, in Sind and the north-west, almost

rainless, or with a rainfall as low as two inches; whilst the highest fall is at Cherra Poonjee, in the Khasia hills, on the north-east frontier, where 600 inches fall in the year. Next to this, the Western Ghauts have the greatest rainfall; at Mahableshwar 253 to 300 inches, and on the Tenasserim coast 180 inches fall yearly. The provinces in the North-east receive rain in rather a different manner; the wind which brings the rains to that part of the continent blows from the south-west, over the Bay of Bengal, till, meeting the mountains, it is deflected. The prevailing wind, therefore, in this region is south-easterly, and from this quarter Bengal and the Gangetic valley receive their rain; when it reaches the mountains in the north-west, it is compelled to part with more of its moisture.

Near the sea, where the land is low and the temperature high, very little rain falls; at Kurrachee it was, in 1879, 1·92 inch. In inland districts, as at Peshawur, in 1879, only 5·84 inches fell; whilst the rainfall in Calcutta averages 63; in Madras, 48·50; in Bombay, 74; in Delhi, 27·5; in Meerut, 27; in Lahore, 21; in Mooltan, 7; in Benares, 37; in Bellary, 18; in Bangalore, 35; in Poonah, 27; in Belgaum, 49; in Kamptee, 22; in Akyab, 198. The amount of humidity in the air also varies greatly. Flat hot plains, like Scinde, where there is little or no rain, have an atmosphere almost saturated, and on some of the lower mountain ranges, in Bengal, and in many districts near the coast in Southern India, the air is very damp. But the elevated table-lands of the Deccan and Central India, and the hot sandy plains of North-west India, have a dry air during the months of May and June, which blows like a furnace blast, heated and desiccated by the burning country over which it has passed!

The north-east monsoon commences gradually in October, and is attended with dry weather throughout the Peninsula generally, except on the Coromandel coast, where it brings rain from the Bay of Bengal, between October and December, after which it is dry until March, when it gives place to variable winds, which last till about June, when the heat is great and the tendency is then from the south. About the end of May the south-west monsoon again sets in, bringing a few showers, known as the lesser rains, before the regular rains set in. In the hill stations of Darjeeling, Mussoorie, Nainee-tal, Murree, Simla, and generally in the elevated provinces of the lower ranges of the Himalayas, also at Ootacamund, Conoor, Wellington, Mahableshwar, in the Neilgherries, and Ghauts—stations at elevations of 5,000 to 7,000 feet—the climate is genial, the rainfall moderate, it

is healthy in summer, and almost as bracing in winter as Europe. These are favourite health resorts, and may, perhaps, become the sites of future colonization, for it seems probable that there the European will thrive and continue to reproduce his race, which it is said would cease to exist in the plains after the third generation.

The following extracts from Mr. J. Talboy Wheeler's "Rare and Curious Narratives of Old Travellers in India in the Sixteenth and Seventeenth Centuries," published in Calcutta in the year 1864, gives a quaint and graphic account of the Monsoons as observed in those days, by Purchas and Van Linschoten.

The former, who visited India somewhere about 267 years ago, says:—

"The mightie Riuers of *Indus* and *Ganges*, paying their fine to the *Lord of waters*, the Ocean, almost vnder the very Tropick of *Cancer*, do (as it were) betwixt their watery armes, present into that their *Mother's* bosome, this large *Chersonesus;* A Countrey full of Kingdomes, riches, people, and (our dewest taske) *superstitious costomes.* As Italy is diuided by the *Appennine*, and bounded by the Alpes, so is this by the Hills which they call *Gate*,* which goe from East to West (but not directly) and quite thorow to the *Cape Comori*, which not only haue entred league with many In-lets of the Sea, to diuide the soyle into many Signiories and Kingdomes, but with the Ayre and Natures higher officers, to dispence with the ordinary orders, and established Statutes of Nature, at the same time, vnder the same eleuation of the Sun, diuiding to Summer and Winter, their seasons and possessions. For where as cold is banished out of these Countries (except on the tops of some Hills) and altogether prohibited to approach so neere the Court and presence of the Sun; and therefore their Winter and Summer is not reckoned by heate and cold, but by the fairnesse and foulnesse of weather, which in those parts divided the yeere by equall proportions; at the same time, when on the West part of this *Peninsula*, between that ridge of Mountaines and the Sea, it is after their appellation Summer, which is from September till April, in which time it is alwayes cleere skie, without once or very little raining; on the other side the hills, which they call the coast of Choromandell, it is their Winter; euery day and night yeelding abundance of raines, besides those terrible thunders which both begin and end their Winter. And from April till September in a contrary vicissitude; on the Westerne parte is Winter, and on the Easterne, Summer; insomuch that in little more than twentie leagues iourney in some place, as where they crosse the Hills to Saint *Thomas*, on the one side of the Hill you ascend with a faire Summer, on the other you descend attendant with a stormy Winter. The likes, saith *Linschoten*, hapneth at the *Cape Rosalgate*, in Arabia, and in many other places of the East.

* He alludes to the Western Ghauts.

"Their Winter also is more fierce then ours, every man prouiding against the same, as if he had a voyage of so many moneths to passe by Sea, their ships are brought into harbour, their houses can scarce harbour the Inhabitants against the violent stormes, which choake the Riuers with Sand, and make the Seas vnnauigable. I leaue the causes of these things to the further scanning of Philosophers; the effects and affects thereof are strange. The Sea roareth with a dreadfull noyse: the Windes blow with a certaine course from thence: the people haue a Melancholike season, which they passe away with play. In the Summer the Wind bloweth from the Land, beginning at Midnight, and continuing till Noone, neuer blowing aboue ten leagues into the Sea, and presently after one of the clock vntill midnight, the contrary winde bloweth, keeping their set-times, whereby they make the Land temperate, the heat otherwise would bee vnmeasurable."

Van Linschoten, who visited Southern India in 1583 or thereabouts, says:—

"The Summer beginneth in September and continueth till the last of April, and is alwaies cleare skie and faire weather, without once or very little raining: Then all the ships are rigged and made ready to sayle for all places; as also the Kings Armie to keepe the Coast, and to convoy Merchants, and the East windes beginne to blowe from off the Land into the Seas, whereby they are called *Terreinhos*, that is to say, the *Land windes*. They blowe very pleasantly and cooly, although at the first, by hanging of the weather they are very dangerous, and cause many great diseases, which doe commonly fall in *India*, by the changing of the time. These winds blowe alwaies in Summer, beginning at midnight, and continue till noone, but they never blowe above ten miles into the Sea, from off the coast, and presently after one of clocke, until midnight the West winde bloweth, which commeth out of the Sea into the Land and is called *Virason*. These winds are so sure and certain at their times, as though men held them in their hands, where they make the Land very temperate, otherwise the heate would be unmeasurable.

"It is likewise a strange thing that when it is Winter upon the coast of *India*, that is from *Diu* to the Cape *de Comorin*, on the other side of the Cape *de Comorin*, on the coast called *Choramandel*, it is clean contrary, so that there it is Summer, and yet they lie all under one height or degrees, and there is but seventy miles by land betweene both coasts, and in some places but twenty miles, which is more, as men travel overland from *Cochin* to Saint *Thomas* (which lieth on the same coast of *Choromandel*), and comming by the Hill of *Ballagatte*, where men must pass over to go from the one coast to the other: on the one side of the Hill to the top thereof it is pleasant clear sunne shining weather, and going down on the other side there is raine, winde, thunder and lightning, as if the world should end and be consumed; which is to be understood, that it changeth from the one side to the other, as the time falleth out, so that on one side of the Hills it is Winter, and on the other side Summer; and it is not only so in that place and Countrie, but

also at Ormus, the coast of *Arabia Felix* by the Cape of *Rosatgatte*, where the ships lie, it is very still, cleare, and pleasant water, and faire Summer time; and turning about the Cape on the other side, it is raine and wind with great stormes and tempests, which with the times of the yeere doe likewise change on the other side, and so it is many other places on the Orientall Countries."

Having given some account of the monsoons, which are the great rain carriers, and of the physical characters of the country which so largely influence its distribution, I now proceed to describe some facts relating to the rainfall, and the effects thereby produced.

It is only within the last ten or twelve years that the comprehensive system of meteorological observation now carried on has been in operation, but it promises to yield valuable results; and one can hardly over-estimate the importance of such researches towards a thorough comprehension of the laws that regulate atmospheric pressure, vapour tension, and the supply of rain, when we consider their bearings on the causes of scarcity and famines which from time to time affect large tracts of country, and sweep away millions of lives.

The annual meteorological reports of India abound in careful, comprehensive, and scientific work, and in information that must ultimately be productive of valuable results to the people of India.

A glance at a hyetographical map of India shows that there are areas of rainfall of various degrees of irregular form and extent, corresponding to the latitude, physical characters of country, and proximity to sea or hills. Let me briefly describe them.

In the north-west corner of India there are arid regions, which have a rainfall of less than 15 inches; in many parts of it, indeed, it is much less; whilst the desert tract of the Thur is to a great extent rainless. This area includes Sind, part of the Punjaub, and Rajputana. Then there is a zone with an annual fall of between 15 and 30 inches, surrounding the arid region on the north and east in a belt of 100 to 200 miles wide, which includes Delhi and Agra. This is the northern dry zone. The upper parts of the valley of the Ganges, Central India, and the eastern coast of the Madras Presidency, have a fall of between 30 and 60 inches.

There is a southern dry zone, which extends from Nassick to Cape Comorin, at a distance between the two seas. The deltas of the Mahanuddi and Ganges, and the lower part of the Gangetic Valley, have a fall of between 60 and 75 inches. There are two belts of excessive rainfall,—one extending

along the Aracan coast, from the mouth of the Irawaddy up the valley of the Burhampootra. The other, on the west coast of India, from Cape Comorin to the Tapti—from the seashore to the summit of the Ghauts! It is in these regions that the most remarkable falls occur, for the reason that they are placed in the direct course of the south-west monsoon, catching its first impact at heights where vapour is most readily condensed into rain. Mr. Bateman told us that at 2,000 feet the greatest condensation takes place in our islands; it is at a greater elevation in India, and the most striking illustration is found at Cherra Poonjee, in the Khasia hills, where, at 4,000 feet above the sea, 600 inches of rain fall in half the year. Here the locality is on the edge of an abrupt mountain ridge and plateau, situated about 200 miles from the Bay of Bengal, the intervening country being flat alluvium, covered with rivers and swamps. Over this the south-west monsoon blows, laden with moisture from the ocean, which is increased by absorption from the wet country over which it passes. On the plateau of Cherra Poonjee the first condensation takes place, and the fall is so great that in a few weeks the plains of the Sylhet district, lying at the foot of the hills, are converted into a sea; whilst a few miles inland, and at little greater elevation, the fall is reduced to less than one-half. I spent my first year in India at this station, and the 610 inches I registered on that occasion gave me an interest in rainfall that I have never lost.

At Mahableshwar, in the Western Ghauts, the conditions are somewhat similar, but there the fall is less, amounting only to about 300 inches. In these instances, we have all the conditions favourable to the production of rain in the highest degree, but these excessive rainfalls in certain elevated regions are quite local, and no more represent the average rainfall of all India than does the dryness of the desert tracts in the north-west; or the heavy fall on the hills on the west coast of Britain, in Cumberland or Scotland, the average rainfall of Great Britain. There is, however, an analogy between India and Britain in this respect, much as they differ otherwise in the nature of the distribution of rain, that the heavy falls at Cherra Poonjee and Mahableshwar are paralleled by the heavy falls on the slope of Ben Lomond, Glengyle, or the Cumberland hills; while the heavy rainfall on our western coasts—the result of the warm moist air coming from the Atlantic and Gulf Stream—resembles the south-west monsoon, which deposits its heavy rain on the Western Ghauts and on the coast of Aracan—proximity to the Equator and high temperature in the latter cases making the effects so much more striking.

The average annual rainfall in Equatorial regions is, I believe, about ninety-five inches; in the temperate regions thirty-five inches, that for the whole of Tropical India is considerably less; while for Hindostan it would be reduced to a lower figure, if we include in the average the almost rainless Thur desert; but, if the rainfalls of the Himalayan be included, the average would, no doubt, be considerably raised. The problems presented by the rainfall are of a comparatively simple character in Southern India and Bengal, where the influence of the monsoon is prominently felt; but in the northern regions of Hindostan, where the influence of mountains, river basins, and the desert come into operation, there must of necessity be perturbation of the direction of the air currents and of the amount of rain. Further observations will, no doubt, in time throw much light on these points.

For the purpose of estimating the general results of rainfall, Mr. Blandford divides India into rainfall provinces, each of which may be represented by a general average, without any disregard of the normal variation of distribution, and be taken as the average rainfall of all the stations included in it; except that when particular stations, such as Cherra Poonjee in Khasia, Mount Abu in Rajputana, Matheran, Mahableshwar, and Baura Fort on the Western Ghauts, &c., have a fall very greatly in excess of the majority of the stations, a fall which must be considered as purely local, only a half or third value is assigned in summing up in the general average.

The following table, taken from Blandford's Meteorological Report for 1879, gives the result of this estimate as regards certain localities. The areas of the several provinces have been measured on one of the Surveyor-General's maps:—

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	Rainfall Provinces.	Area Square Miles.	Number of Stations.	Mean Rainfall, 1878.
				Inches.
1.	Punjaub Plains	118,000	29	21·66
2.	N.W. Provinces and Oudh...	82,000	42	37·35
3.	Rajputana........................	67,000	18	24·36
4.	Central India States	89,000	21	42·00
5.	Behar	30,000	8	42·31
6.	Western Bengal	38,000	6	51·24
7.	Lower Bengal	54,000	21	67·52
8.	Assam and Cachar	52,000	13	98·18
9.	Orissa and Northern Circars.	27,000	13	45·92
10.	South Central Provinces......	61,000	14	49·22
11.	Berar and Kandesh	43,000	11	30·08
12.	Guzerat...........................	54,500	9	35·98
13.	Sind and Cutch	66,500	10	9·24
14.	North Dakhan..................	48,000	14	28·68
15.	Konkhan and Ghauts	16,000	10	118·77
16.	Malabar and Ghauts	18,000	8	113·95
17.	Mysore and South Hyderabad	84,000	10	27·01
18.	Carnatic	72,000	29	33·34
19.	Arakan	11,000	4	171·05
20.	Pegu	32,500	6	74·91
21.	Tenasserim	10,500	4	170·73
	Total..............	1,074,000		

Certain areas are yet imperfectly represented by rain-gauge stations, such are the Thur desert (about 65,000 square miles) in Northern Hyderabad, Jaipur, Singbhoom, and South Rewah, which, taken together, form about one-sixth of the whole. Omitting these from consideration, it appears that, on a rough approximation, there was, in 1878, a rainfall equal to 4·9 inches in excess of the average, over the whole of India and its dependencies, omitting seas and islands. This shows that, although the general character of the seasons is pretty constant, yet that there are annual fluctuations which perhaps recur in cycles and are more remarkable in some districts than in others; years of deficiency being conducive to imperfect irrigation of the land, which results in scarcity,—sometimes in famine.

In our own favoured land where, with all its uncertainties of a variable climate, we have happily little or no experience of the desolation caused by a deficiency of rain, we can hardly understand what is implied by a failure of the rains in India. A charming and talented writer* in India has recently drawn a most graphic picture of it in the following words: "We

* P. Robinson.

in the West can hardly understand what it means that 'rain has fallen in India,' and it may seem, at first sight —so wide is the world, and so far apart the interests of races—a strange thing that a fall of rain should be magnified by such language as is often used. And yet in a year of threatened famine it is not easy to find in history a greater blessing than the sudden relief of a shower. Those who best know the land so sorely athirst,—who remember the dreary, leafless months, when, scathed by hot winds, the country side lies bare and brown under a sky of relentless blue, and who have had, experience, too, of that first day of gathering clouds, when the face of Nature betokens a welcome to the coming rain; when almost in a single night the heat-cracked plains clothe themselves with grass, the fainting trees are lit up with the brightness of young leaves, and the world awakens on the morrow to a surprise of fertility,—these can best picture to themselves the true spectacle of the change that transfigures the face of India, when the clouds burst upon the empty fields. During the months of July, August, September, and October, which in other and more kindly seasons are rich with springing vegetation, and glad with the grace of standing corn, India lay, in 1877, wasting under a remorseless sun a great length of deadly days, while the ploughs stood idle under the old peepul tree in the centre of the village, and the men gathered gloomily about the headman's house; and sadly along the dusty highways went the tinkling feet of the women sent forth to the shrine by the river to supplicate the Goddess of Rain; day by day the peasant doled out for the present meal the precious store put by for sowing of his fields for the next year's harvest; day by day the women going to the well found their ropes yet another inch too short for the bucket to drop into the shrinking water. The cattle, long ago turned loose to find their food where they could, had given up the vain search in the fields, and lingered about the villages sniffing at the empty troughs, and lowing impatiently for the evening meal of bitter leaves which the lads were beating down from the trees in the jungle. And then there came over many a sad village a day when the bucket brought up no water from the well, when the grain-bag was empty and the cattle dead. Famine, stealthy and pitiless, prowled from village to village.

"Along the raised pathways between the empty fields the sad processions of mourners filed all day, bearing to the river-side the bodies of the dead. Yet the sun still flamed ruthless in the sky. The villages gradually emptied of men; some had perished, while the rest had fled from their homes. To

stay and hope was to die. At last came this rain. It did not bring food, but it brought the assurances of future harvests, and set the poor souls to work and to hope. Even food would grow cheaper, and be more freely obtained as those precious drops pattered; for the rain came at the right time. Just when further hope seemed useless; when, from the Indus, all along the Ganges valley to the Bay, from Oude, 'the garden of India,' and the principalities of the Rajput and Maharattah; from the wild fastnesses of Sind to the palm-fringed shores of the Eastern coast—the danger of a second year of drought was gathering force. Just when it seemed inevitable that half India must be involved in the disasters of Madras, the rain-clouds hurried up in a night, and the peninsula awoke from despair."

And after a most eloquent and touching account of the sufferings during July, August, and September, when the natural rain was withheld, he goes on to say:—

"So the days wore on to October. The sowing of seed for next year's food now seemed hopeless, and another year of famine inevitable; but the people did not repine. They waited patiently and pathetically, closing in round the famine-works and doing their day's labour for a day's food, enduring the 'evil times' without hope but without murmur. Indeed, hope looked like folly. The news came from every side that crops had failed. The horizon of disaster seemed expanding every day. Even the stout heart of the English official began to fail him, and he spoke dismally of the future. The sky was still unflecked with clouds, and a great multitude was dying at his gates. Then, suddenly at last, when it seemed almost too late, nature relented. A shadow of clouds had grown up on the horizon, the great rain-wind blew, driving a tempest of dust before it, whirling the dead leaves from the trees, and signalling that help was coming. The birds could be seen gathering in the sky, and the cattle turned their heads to the wind, for they could scent the approaching showers. There would be a strange gloom while the dust-storm was passing, and the people would throng, gazing at the clouds, or waiting for the rain that they knew was close behind. The streets would be filled with men and women, and all hands would be idle, and all tongues silent, and then, lo! the rain.

"First, great sullen drops, pattering one by one, and then, as if it could not come down fast enough or thick enough, the torrent descended. Not a mocking shower, but a glorious life-saving deluge, brimming the tanks to overflowing, and sending the dead weeds swirling down the nullahs. In instant response the earth broke out into life. From forest

and hill the familiar cries of Nature were again heard, the crane trumpeting to his mate as he stalks among the waving sedges, the cry of curlew and plover wheeling above the meres, the clamour of wild fowl settling upon the waters, the barking of the fox from the nullahs. The antelopes found out their old haunts, and from the villages the hyena and jackal skulked away to ravine and cave. Men and women came straggling back to their villages; ploughs were dragged afield; and, where a week ago was hopelessness and desolation, the only sounds of living things, the cries of beasts and birds over the corpses, there awoke a glad renewal of busy peasant life."

Something has been said and written on the influence of the solar spots on the cyclical changes that involve recurrence of dry seasons, and consequent scarcity or even famine, but no very definite conclusions have been reached in regard to their value as causal agencies. Mr. Blandford, however, says that he considers the evidence in favour of the general fact that the solar heat increases and decreases *pari passu* with the spots in the photosphere, is at least much stronger than any that has been brought forward in favour of the opposite view, but the numerical value of the variations has yet to be ascertained.

The relation of the sun spots to rainfall is yet a *quæstio vexata.*

The following are the Rainfalls of some of the principal Stations in India for 1879, compared with the average yearly falls :—

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Stations.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Total.	Average.
Calcutta	......	0·28	......	......	3·07	7·52	12·21	12·54	6·22	2·41	......	0·42	44·67	62·95
Dacca	......	0·75	0·06	0·51	4·42	14·37	20·51	13·71	13·28	6·29	......	0·90	74·80	73·29
Chittagong. .	0·36	......	0·11	0·07	4·28	36·58	25·98	12·84	7·37	6·71	......	1·01	95·31	103·36
Sibsagar	1·60	0·62	1·55	7·51	21·01	17·28	19·18	16·40	16·63	3·93	......	0·38	106·14	94·45
Silchar	......	0·51	5·48	4·73	16·26	32·49	17·75	22·82	10·22	2·83	......	0·41	113·50	117·40
Cuttack	......	0·07	1·15	......	8·52	3·57	12·23	18·96	9·44	4·89	0·25	1·54	60·62	55·89
Hazaribagh .	......	0·60	......	......	1·47	7·42	13·09	12·17	7·07	2·53	......	......	44·35	48·33
Patna	......	1·37	......	......	0·02	5·23	9·78	12·87	8·93	6·53	......	......	44·73	40·26
Darjeeling ...	......	0·47	......	1·51	13·36	27·67	53·53	40·68	19·84	3·63	......	0·23	160·92	120·17
Allahabad ...	......	0·07	0·02	......	......	9·26	6·01	9·58	13·95	3·46	......	......	42·35	38·45
Lucknow ...	0·17	0·02	......	......	0·05	3·70	18·12	8·47	5·67	1·96	......	0·16	38·32	39·52
Meerut	0·56	1·32	0·75	0·30	0·05	1·87	12·49	13·81	3·10	0·40	......	0·92	35·57	27·44
Delhi	......	0·21	1·03	0·05	......	6·79	15·28	8·99	2·29	0·09	......	1·22	35·95	27·49
Agra	0·66	0·11	0·15	0·03	......	3·02	7·93	10·62	6·60	0·28	......	0·20	29·60	25·77
Jhansi	0·40	......	......	......	......	2·90	16·76	17·10	9·17	0·91	......	......	47·24	35·08
Agmere	......	0·89	0·27	0·02	0·13	6·56	0·38	16·71	2·03	0·10	......	0·51	27·60	22·90
Saugor	......	0·85	......	......	0·75	4·93	11·88	13·81	3·23	3·88	......	......	39·33	46·90
Jubbulpore .	......	0·73	......	......	0·06	3·60	10·84	17·45	8·67	3·92	......	......	50·27	52·24
Mooltan	......	......	1·73	......	......	1·32	0·81	1·03	......	......	......	......	4·89	7·41
Lahore	......	0·01	1·32	......	0·01	5·48	1·13	7·49	3·12	0·17	......	0·45	19·18	21·38
Peshawur ...	......	0·46	2·73	0·24	0·14	0·05	0·47	0·97	0·16	......	0·10	0·52	5·84	14·66
Ranikhet ...	0·23	1·55	3·32	0·53	0·20	9·65	21·78	13·30	2·01	2·40	......	1·22	56·19	48·56
Chakrata ...	0·36	1·56	5·65	0·70	0·22	12·37	15·91	27·62	6·41	0·75	......	0·81	72·36	61·07
Indore.........	......	0·61	......	......	2·29	6·16	3·45	7·79	14·67	3·29	......	......	38·26	36·30
Deesa	......	0·86	......	......	......	5·42	9·42	15·12	1·59	0·01	......	......	32·42	24·13
Kurrachee ...	......	......	1·00	......	......	0·04	......	0·87	0·01	......	......	......	1·92	7·37
Bombay	......	......	0·03	......	5·23	16·56	11·21	22·36	5·61	0·40	......	......	61·40	74·06
Belgaum......	......	0·05	......	0·64	5·35	13·40	8·66	17·13	1·40	3·81	4·40	0·07	54·91	48·15
Nagpur	......	0·63	......	......	5·92	13·46	8·48	13·50	6·54	3·65	......	......	52·18	43·71
Bellary*	......	0·39	......	0·59	3·03	1·50	7·34	2·98	3·54	3·03	0·86	0·02	23·28	17·57
Bangalore*...	0·33	1·38	3·19	0·26	6·58	2·93	7·20	3·56	4·76	8·35	2·13	......	40·67	35·46
Madras*	1·30	......	1·50	......	4·43	2·10	4·30	6·61	0·54	18·23	10·91	4·33	54·25	48·56
Rangoon......	0·04	......	......	4·57	12·17	15·12	19·14	20·25	18·66	8·48	15·26	......	113·69	101·10
Akyab.........	......	......	......	......	10·82	54·02	60·10	58·83	24·29	16·02	......	3·16	227·24	197·98

* The fall at these three Stations in September, October, November, and December, shows the effect of the north-east monsoon as a wet wind.

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I have taken from the meteorological report for 1878 the rainfall in a number of stations in illustration of the influence of season and the monsoons in different regions of India; 1878 seems to have been an exceptional year, with peculiar variations from the ordinary conditions, for, whilst unusually dry in some, it was unusually wet in other districts. The general result was an average rainfall for the whole country registered, 4·9 inches in excess of previous years.

The following averages of a number of previous years are instructive. In Calcutta, for example, 65·80 inches fell, the greatest falls being in the months of,—June, 11·78; July, 12·77; Aug., 13·96; Sept., 10·15.

In Chittagong, the greatest falls were in,—June, 21·35; July, 21·93; Aug., 21·71; Sept., 14·05. The whole rainfall was 103·7.

In Bombay, the whole rainfall was 74·20. The greatest was in,—June, 20·95; July, 24·27; Aug., 15·21; Sept., 10·71.

In Kurrachee the fall was 7·61. The greatest being in,—July, 2·97; Aug., 2·10; Sept., 0·81; Dec., 0·22; Jan., 0·67; Feb., 0·26.

In Mangalore, on the west coast, in the full intensity of the south-west monsoon, the fall was 134 inches. The greatest falls were in:—June, 40·09; July, 37·68; Aug., 23·14; Sept., 11·70; Oct., 8·55.

In Madras, 48·15 fell. The greatest falls were in,—Oct., 10·73; Nov., 13·0; Dec., 4·99; Jan., 0·65, showing the influence of the wet north-east monsoon.

In Tinnevelly, the fall was 28·16 in the whole year, greatest in,—Oct. 6·25; Nov., 9·86; Dec., 2·63; Jan., 1·55.

In Southern India at several stations, as, for example, Coimbatore, Bangalore, and others, both monsoons are felt, and a certain amount of rain is due to each.

Irrigation.

Though a great part of the continent of India is amply supplied with rain, there are extensive regions where the normal quantity is so small that it is insufficient to produce the crops that are necessary for the support of the population, and where, without the aid of artificial irrigation, the land would be sterile. This irrigation is effected by reservoirs, canals, and wells. In regions where the yearly rainfall is less than 15 inches irrigation is always necessary, such are the arid zone in the north-west, including most part of the Punjab, the great desert tracts of the north-west, and in that known

as the southern arid region, occupying the central portion of India from Nassick to Cape Comorin!

In regions having a rainfall of between 30 and 60 inches, such as the upper part of the valley of the Ganges and the eastern coast of the Madras Presidency, irrigation is often needed, and great distress has been caused by the want of it. Where the rainfall is between 60 and 75 inches, as in the deltas of the Mahanuddi and lower part of the Gangetic valley, irrigation is looked on as a luxury—often useful, but not necessary, except in exceptional years. There are two belts of excessive rainfall—the coast of Aracan, extending from the Irrawaddy to the valley of the Burhampootra; and the west coast of India; where the need for irrigation never exists. In those wet belts, where a superabundance of rain falls, embankments are necessary to preserve the crops and villages from destructive floods; whilst the maintenance of the river embankments in Lower Bengal is an important part of the duties of the irrigation department; for the cultivation of the land is entirely dependent on their efficiency. This, however, is the result of the land lying below the flood level of the river rather than the excessive rainfall. There are upwards of 2,000 miles of such embankments in Bengal, under the charge of the Irrigation Department, kept up by the State. Mr. Bateman alluded to artificial irrigation in Ceylon and India, and to the great works that had been constructed in past ages for the purpose, many of which had fallen into disrepair and disuse; and he mentioned the canals that have been constructed by the British Government with the view of irrigating those tracts where the natural rain supply is deficient during the whole year, or where it is so partial that it fails to supply the needs of cultivation, and he contrasted the condition of a country so situated with our own more favoured islands, where drought is infrequent.

The Government of India has given much attention, of late years, to artificial irrigation for those districts that are most in need of it, and many gigantic works have been completed, whilst others are in course of construction for this purpose; some are altogether new, others are the reconstruction on former lines of old works of the Hindoo and Mahomedan periods, and the importance they must have attached to irrigation is manifested in the canals, anicuts or dams of rivers and reservoirs, many in ruins, left by them. It would be impossible for me now to give a detailed description of the irrigation works, ancient or modern, in use in India. I can merely give a general sketch of the great canal system actually in existence, supported and carried on by Government.

About sixty years ago the British Government seriously took up the subject of irrigation by canals or other great works; since then, the work has been steadily going on, and with it the names of Cautly, Cotton, Fife, Baker, and others, are honorably associated; nearly the whole of the peninsula is now provided in those regions where water is needed, and a vast area of land, that would otherwise be sterile, is brought under cultivation. The works, consisting of canals of various sizes, dams or anicuts, lakes and tanks, extend from Himalaya to Comorin, and, to effect this, great rivers, such as the Ganges, Indus, Jumna, Sone, Sutlej, Ravi, Mahanuddi, Godavery, Kistna, Cavery, Colerun, Tunga-Badra, and Tapti, have been laid under contribution, with many other lesser streams, for the formation of artificial lakes and reservoirs; whilst several others are in project. An idea of the magnitude of the work may be derived from the length in miles of the canals that form the canal system in India.

The total length in Bengal, Madras, and Bombay, amounts to 4,900 miles; but this does not include the Tanjore system, which is 700, the inundation canals of the Punjâb, 1,550, or the canals of Sind, 5,600 miles. Thus there are 12,750 miles of lesser or greater canals, whilst the total length of the distributing canals is unknown. In Northern India alone, however, it amounts to 8,300 miles. The area now irrigated amounts to 1,900,000 acres in Madras and Bombay, 300,000 in Behar and Orissa, 1,450,000 acres in N.W. provinces, 1,350,000 in Punjâb, and 1,250,000 in Sind; in all, 6,310,000,—nearly six and a half millions of acres. The area irrigable by canals is yet considerably greater than even this large total, so that the system is capable of extension. The capital outlay by the State on this canal system may be set down at twenty and a quarter millions sterling, on which the net returns yield an interest of six per cent. Sir R. Temple says: *—" Apart from the direct receipts from these canals, many indirect benefits accrue. These benefits are represented by the security afforded to agriculture, the assurance provided for the people against the extremities of drought and famine, the protection of the land revenue, the instruction of the husbandmen by the example of the superior husbandry established, and the introduction of superior products. The value of the canals during the recent famines has been inestimable. Without irrigation, these calamities, great as they are, would have been infinitely greater. The value of the produce which the canals saved in order to feed a famishing people, equalled the capital outlay on their construction."

* "India in 1880."

Another point of view from which meteorology is most important in its bearings on the material prosperity of India is the effect which it exercises over the sanitary condition of the people. There can be little doubt that public health is greatly affected by the rainfall, and that fluctuations or extraordinary departures from the normal state are attended by fluctuations in the standard of public health. The diffusion and activity of epidemics are probably influenced by it. It would be saying too much, perhaps, to assert that the fluctuations in the death-rate are altogether due to variations in the rainfall, but that they are to a great extent influenced by it seems to be proved by what obtains all over India.

The following* appears to have been ascertained in relation of climate to epidemics :—

1. If epidemic cholera be about, its intensity will be increased by continued dryness, evaporation, and high temperature. If cholera exists under this form, heavy rain will greatly diminish it, or wash it away.

2. Dryness, heat, and rapid evaporation reduce the intensity of fevers. Rain following, greatly increases their intensity. But the effect is not what can be called immediate. The rain must accumulate and the ground be soaked; as soon as drying up begins, fever augments until the evaporation reaches a certain intensity, when it declines. It is not so much the great amount of rain as the soaking and saturation that does the mischief. In some places fever declines very much when the country is completely flooded, but increases in intensity when the rain ceases, and drying up begins.

3. Small-pox in India does not appear to be related to rainfall. It augments with increase of heat, and so continues till colder weather arrives, irrespective of the amount of rain.

4. Rain with cold and high temperature range appears to augment the liability to bowel diseases, but not to a very great degree.

There is yet one point to which I would refer, though I can only do so very briefly; it is the influence of the rainfall on the growth of forests, and their effects on climate. There is reason for believing that some of the desert plains of India were at one time covered with trees, and that when they were so the climate was less rigorous in its extreme heat than it now is. When we think that the desert regions in the north-west were at one period the seat of early Hindoo civilization and population, it is obvious that the physical conditions of the country must have been very different to what they are now, and it seems probable that the change is due to destruc-

* Dr. Sutherland.

tion of trees. The cultivation of forests, therefore, is a matter of the greatest importance, for, not only do they temper the climate by the moisture they exhale, but they tend to cause rain where there would be none.

The subject of rainfall is one that involves so much, and that suggests or leads to so many collateral inquiries that it is difficult in discussing it to draw the line where one would stop, but I feel that I must do so here, for I have exhausted the time at my disposal in giving what, after all, is but a mere sketch; I trust, however, that it may have conveyed some useful information on a subject that is fraught with interest to 250,000,000 of our fellow-subjects.

The Chairman.—I have to return our thanks to Sir Joseph Fayrer for his very interesting and useful paper. It is now open for any present to make remarks upon the subject.

Mr. J. F. Bateman, F.R.S.—I am happy to think that a paper of mine should have suggested so valuable and interesting a communication as that which we have just had from Sir J. Fayrer. There can be no question that the registration of meteorological facts all over the world is of great service; but the object of my paper was the particular one of confining the observations made on this subject to the British Islands, with a view to showing that it was necessary to take all the circumstances into consideration with the practical object of providing for the floods which occasionally deluge the country, and making a fair estimate of the quantity of rain which might be collected from a given area. I desired to show that it was not, as has been falsely assumed by many meteorologists, the mere elevation of the country which increased the quantity of rain, and I showed that the heads of all valleys and the first land (if the hills are only of a certain height where they are swept over by the south-west wind, which brings the largest quantity of aqueous vapour) received most rain, while as the south-west wind proceeds gradually to the east there is a lessening quantity of rainfall. I am happy to see that the observations of Sir Joseph Fayrer have corroborated this statement. But in the districts he has spoken of the difference in the rainfall is so large that little practical result can be obtained from the observations except that it is found that there is a very large rainfall in the mountains to the west, while in some of the districts beyond there is next to none—the difference being as between a rainfall of less than 2 inches, and the enormous amount of 600 inches, so that about 300 times as much rain falls in one district as is registered in another upon the average of years, there being certain months during which no rain falls, while there are other months in which as much as 50 or 60 inches of rain are occasionally registered. In the tables which Sir Joseph Fayrer has given, which are exceedingly interesting, there are registers of rainfall, showing that in some places no rain whatever has fallen in the months of January, February, March, and

April, while in May, June, July, August, and September, the rainfall, has amounted to 60 inches and upwards. The provision that has to be made under these circumstances is, therefore, of two kinds. They have first to provide for the construction of roads, railways, and other works, so as to pass the floods which arise from the prodigious quantity of rain which falls at certain seasons of the year, and they have also to provide works of irrigation in those parts where the rainfall of the wet season can be utilised for purposes of cultivation, or any other use to which it can be applied for the benefit of mankind; and in these cases they have to base their calculations on the length of the drought which may be expected, and the period during which they must maintain a sufficient supply of water by artificial means. They must of course consider the capacity of the reservoirs they have to construct for the purpose of collecting and storing the rainfall which is obtained in such abundance during the rainy months. These are practical questions which can only be deduced from such observations as those which Sir Joseph Fayrer has brought before us. Therefore, quite apart from the interest the subject intrinsically possesses, they are of the greatest interest and importance to mankind in reference to their arrangements for works of improvement, or the mechanical operations by which man is able either to control the floods, or to impound the water falling in the wet seasons for use in the dry seasons. There are so many interesting points in connection with the subject of meteorology, quite apart from those relating to the practical objects to which I have referred, that it is a matter in which I can well understand a great many people will feel an interest. Whether we shall ever find out and apply the laws which govern the fall of rain, so as to convert them into an exact science, I doubt; but at all events a great number of observations, extending over a large area of the earth, must prove of the greatest possible benefit in enabling us to form opinions as to the quantity of rain which has produced, in flat districts, deltas like those in Egypt and lower India. The difference in the fall of rain is so great, and the purposes to which the rainfall is applicable are so varied, that we cannot help thinking the distribution of water must necessarily call forth the intellect and the energies which God has bestowed upon us for the purpose of enabling us to make use of the great advantages which He has conferred upon us for applying the surplus rainfall of one district to counterbalance the deficiency of another. In this respect the observations of Sir Joseph Fayrer must be of the greatest advantage, quite apart from the practical results which it was the object of my paper to direct attention to. (Hear, hear.) I may mention one circumstance that has also been alluded to by Sir Joseph Fayrer, namely, that evaporation is constantly going on, and I have known as much as five inches of snow disappear during an east wind, although there was no thaw and the weather was freezing the whole time; the effect of the dry east wind prevailing over the whole country being to produce this result. This fact shows that evaporation depends not so much on the temperature as it does on the dryness and capacity of the air to absorb moisture. Thus in the

tropics, through which I have passed, I have found that the atmosphere has been so saturated with moisture that at night, when the temperature has become reduced and condensation has taken place, the deck of the steam vessel would be absolutely wet, as if recently washed, owing to the deposition of dew or moisture upon the surface. (Applause.)

Dep.-Surgeon-General N. Chevers, C.I.E.—I was for a long time a near neighbour of Sir Joseph Fayrer's in India. I have been at Chittagong, where we had about 160 inches of rainfall in the year. It is pleasant to remember that, the very first, I believe, of the numerous illustrations of natural science in every part of India by which Sir Joseph Fayrer has enriched our literature, was a contribution to the meteorology of Burmah, in which he undertook the very difficult task of obtaining for a specified time, the hourly temperature, the rainfall, and the barometrical readings of that district. He and Mr. J. Bedford were the only men who were the actual pioneers in this work. Then followed what was certainly a violent measure on the part of the Government, and I am afraid that Sir Joseph Fayrer and Mr. Bedford are to be charged with bringing it down upon us. The Government sent us a most terrific paper, upon which already hard-worked men were expected to register the dry and wet bulb and barometrical readings, and the direction of the wind, six times a day, to observe also during the night what were the prevailing winds; and, at the end of the 24 hours, to register the rainfall. I am now speaking of two and thirty years ago, and some of the results were very curious. For instance, some barometrical readings, which Mr. Bedford told me had been sent to him, were of a very wonderful and surprising character; upon his inquiring whether they could possibly be true readings, the observer wrote back to him, saying, "You are employed in registering atmospheric phenomena; this is an atmospheric *phenomenon*, and you must register it." There was one phenomenon for which I can vouch. A surgeon who was very much overworked, made the duty over to the sub-assistant surgeon, who, I am afraid, made it over to a native doctor, who observed that a certain wind blew "due east-west" for a whole week. (Laughter.) This was registered in one of the documents, and there may have been well nigh as little accuracy in some of the other conjectural registers. It was my duty, as secretary to the medical board, to make over the whole mass of these records to one of the brothers Slagenthweit, who afterwards died in India, who, I believe, was unable to publish them; still, many of them were true and accurate documents, very carefully compiled by such men as Sir Joseph Fayrer and Mr. Bedford; and, if they could be recovered now, they would give some very curious and interesting information. This was all before the time of Mr. Blanford. There was one point which interested me very much in Sir Joseph Fayrer's paper, and that was the allusion made to the effects of tree vegetation on the rainfall. I remember one or two spots which were wide wastes of sand swept bare by the mighty river the Brahmaputra, and which were left entirely without the appearance of vegetation for several months in the year; but we

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took certain pieces of this land, enclosed them, irrigated and cultivated them, and before five or six years were over, those sands were tolerably productive gardens. There has always been a great want of wood in India, and fire-wood is very expensive. There was a great sacrifice of wood caused by the introduction of railways. There was an extreme, almost a rabid, anxiety to get wood for sleepers, and large forests were cut down and carted away for the purpose. When I first went to India, thirty-three years ago, no person had any need to be what is called weatherwise. The seasons were then almost as regular in India as day and night are in England. You knew perfectly well in Calcutta that on the 20th or 21st of June the rains would set in, and so on with regard to the rest of the climatic changes. Everything was fixed; but of late years, and especially since heavy cyclones have been frequent in southern India, there has been a difference: whether this is a mere coincidence or stands in the relation of cause and effect I am unable to say. At any rate the climate of Calcutta is beginning, as to the rainy season, to be in some years most uncertain. In olden times, from the 20th of June until September, we had heavy rains every day, generally until about five or six o'clock in the afternoon, which was our driving time, and then we could get out and take a little exercise. The rainfall amounted to some 60 or 70 inches in the course of the year; but, of late years, you have sometimes almost a month in the rainy season without any rain whatever. The rainy season was a comparatively cool one, because the sun was kept off by the clouds. Now, that shelter is to a great extent withdrawn, and the sun comes down upon you with most intense heat. Coincidently with this it is to be noticed that Calcutta, which is not a very ancient place, dating from about 1680, used to have in its vicinity beautiful forest trees, such as the tamarind, the peepul, and a great variety of others. It was, in old times, thought a great virtue to plant avenues of trees under which the troops and wayfarers could pass, and you see them still remaining on some of the old roads from Burhampoor, and between Calcutta and Barrackpore. It was the almost sacred duty of the Zemindar to have mango groves planted, which supplied the people with a food that is, perhaps, second only in value to rice in some of the districts, especially in Behar. Since the cyclones and the construction of the railways, the great trees of Calcutta have almost entirely disappeared; and I cannot help thinking there is more than a mere coincidence between the disappearance of these trees and the great irregularity of the seasons in the Calcutta district, so that now one must be exceedingly weatherwise to predict what sort of a day one is likely to have. The great thing for scientific men to do is to endeavour to equalise the fall of rain in some of those unhappy countries where it is so uncertainly distributed. I believe that trees are beginning to be more plentiful in Scinde than they were. The objects to aim at are, first of all irrigation, then of course growth of the crops, and then the planting of forest trees.

Mr. W. Griffith, Barrister-at-Law.—The subject is one of so much interest that I am sure a paper upon it from any member of the Victoria

Institute must be worthy of attention, more especially one from a gentleman of such authority in the scientific and medical world as Sir Joseph Fayrer. Those who know the high position he has occupied in India, the great services he has rendered, and the opportunities of observation he has had, must admit that a more trustworthy and competent witness could not appear upon the scene. He has given us a great deal of very valuable information as to the effect of the rainfall not only on the famines of India, but also the health of the people,—on such diseases as cholera, fever,—and other matters connected with Asia. I was glad to hear what he said with regard to the forests, which may in time to come be of so much importance in that country. He has told us that the rain is produced by the monsoons breaking on the mountain ranges during certain months in the year. I remember some years since reading in Alison a statement that during six months of the year the rainfall of India was designed by providence to produce fertility in that country, while during the other six the melting snows swelled the rivers and produced a similar effect. I would, with all respect, ask Sir Joseph Fayrer whether this is a fact. Of course, I merely quote the statement on the authority of that eminent historian; but the authority of a witness who has lived so long in India would be valuable, as tending to enlighten us upon that point, because some seem to think we can have no exact science on the question of rainfall. The interesting map exhibited illustrates with considerable accuracy, the results of Sir Joseph Fayrer's observations, showing that in Scinde the rainfall does not exceed 10 inches, while in various parts of the country it is over 100 inches. In a country with such an opportunity for the Government to exercise its powers, to remedy the want of water, and to produce fertility among the arid districts, any postponement of irrigation works is to be deprecated. Of course, India is so extensive a theme that those only who have the best acquaintance with its history and its present condition can dilate upon these subjects to our satisfaction. It is very interesting to consider the history of the past military achievements of England in that part of the world, and the results of our statesmanship in consolidating that mighty empire, and to remember the great results achieved by a few British merchants. One cannot but contemplate with some satisfaction the benefits of our rule in that country; there is no doubt that we have been the means of producing peace and improving the administration of justice, and it is satisfactory to find that we are doing much to promote the prosperity of the natives; that we are considering the education of the people, and the means of averting any of the calamities that are likely to befall them, while we are promoting the productiveness of the soil by those great works of irrigation to which Sir Joseph Fayrer has referred. I was surprised to hear that those works had been extended to thousands of miles of canals. It is also to be remarked, and it is perhaps an argument why these works should be demanded of and carried out by us, that we are the landlords of the country, and that

whatever benefits we may produce must benefit ourselves by increasing the rent. This, of course, is a mere utilitarian argument. It is important that we should bind the natives to ourselves by anything that will tend to make them more satisfied. In times past they have had the opportunity of witnessing our military rule, and they may have had cause to admire our administration of justice; and I think we ought to consider it a hopeful sign that they are now to have the opportunity of finding that we are doing all we can in other ways to promote their welfare, and to increase their prosperity. I am glad we have had such men as Sir Joseph Fayrer out there, and I trust there will be many more who will go and do as he has done, and produce the same amount of benefit to that important country.

Col. J. A. Grant, C.B., C.S.I., F.R.S.—As the hour is getting late, I should have preferred to hear Sir Joseph Fayrer's reply to saying anything myself; but I may allude to the equatorial region of Africa, in which I was with Captain Speke, where we had only 49 inches of rain. The altitude of the country is 4,000 to 5,000 feet, and as one goes northward to 5° north latitude and 2,000 feet altitude, the country is more of a desert, and resembles parts of Ceylon in there being a small rainfall. In the region of 3° south latitude, where the rains reach both the Congo and Nile, the fall of rain may be 60 inches. But, as I have said, I only wish to hear my old friend Sir Joseph Fayrer's reply; I have been delighted to hear such an admirable paper.

General Maclagan, R.E.—Sir Joseph Fayrer has described the great inequalities of water distribution in India. India suffers sometimes from excess of rainfall, causing destructive floods, and sometimes from deficit, causing much distress from scarcity of water. And these two things may happen at the same time in different parts of the country,—a country not only of great magnitude, but of which the physical features and conditions vary as much as the different countries of Europe, and in some respects much more. A great problem in India, where it may be said there is ordinarily an abundant supply of water upon the whole, is how to make the most of this most valuable gift, and to prevent or diminish the injury it causes. Works have to be constructed in India for both objects, at one place for removal of excess water, or protection against it, at another for catching and economising every drop. Of the irrigation canals that have been referred to, some flow continuously throughout the year, the quantity of water admitted being to a certain extent under regulation. Others, more simple works, known as *inundation canals*, fill only when the rivers rise from the melting of the snows, and then from the periodical rains in the hills. Reference has been made to the effects of clearing forests in India. There has been, we know, extensive clearance in some parts, in past years, before the British occupation of the country. It is on record that wild animals used to be hunted in great forests, where now there is not a tree. And there can be little doubt that these clearances have affected the climate. But it can scarcely be said that the supply of the railway requirements in

our own time has helped to increase the injurious clearance of forests in India. The requirements are of two kinds, timber for sleepers and buildings, and small wood for fuel. The *deodar* timber, which in Northern India is the wood chiefly used for sleepers, as it is not liable to the attack of white ants (other woods have to be protected by creosoting, &c.), has been chiefly supplied from native hill states. It is true that under native management there was much wasteful and indiscriminate felling of the timber, the rulers looking only to immediate gain, regardless of the future. The British Government has taken a lease of some of the principal hill forests of deodah and other pines, and in the hands of the Forest Department the felling is under careful and systematic management, due care being taken for reproduction of timber trees and increase, in certain places, of forest area. The provision of fuel, and the management of the jungle tracts in the plains, from which fuel supplies are obtained, are likewise under careful regulation; and extensive fuel plantations in selected places provide for continuous supply and reproduction. The untrustworthiness of the meteorological registers, to which allusion has been made, was due to imperfect arrangements, imperfectly qualified agency, and imperfect means of compiling and examining the results. Matters are differently managed now, and a competent meteorological department has been organised. Many have heard the old story of the native official at a rural station (who, among other duties, had charge of the meteorological instruments), making things ready, on one occasion, for the expected visit of the Commissioner of the Division, who would be sure to ask to see the meteorological instruments. They could all be examined and read except the rain-gauge. The Commissioner might be disappointed if it had nothing to show, so a jug of water was poured in that he might find something to observe in the rain-gauge too! We may fully trust that, under Mr. Blandford, meteorological records will be obtained of great value and importance to India.

Surgeon-General Gordon, M.D., C.B.—I have been a good deal in India, and can endorse almost everything that has been stated by Sir Joseph Fayrer, especially with regard to the important bearing which meteorology has upon certain kinds of disease. Sir Joseph Fayrer has alluded to the prevalence of particular kinds of disease, according to the particular atmospheric conditions of the country. In so far as those atmospheric conditions at particular periods, or at the same period of the year, are very variable in different parts of the large continent of India, so do we find the phenomena of disease vary in a similar manner. That is to say, the disease which prevails in one part of India, and at one period of the year, differs in many respects in its phenomena from a similar disease prevailing in another part of India. I noticed that it was represented by Sir Joseph Fayrer that there are certain epidemics which have a natural relation to meteorological conditions, while there are others with regard to which similar conditions do not seem to be established.

With regard to those that are connected with meteorological conditions, such as cholera, we can almost trace the advance of cholera from one part of India—namely, from Lower Bengal upwards, according to the advance of the season—year by year, almost with unerring certainty. The cholera, beginning in Lower Bengal, especially in Calcutta, about the month of February, advances steadily upwards along the banks of the Ganges to Berhampoor, Dinapore, Benares, Cawnpore, Meerut, and so on to Peshawur, reaching the latter place about the latter part of autumn. It then frequently advances north and west, even in the winter season. But there is another respect in which the meteorological condition of India has a very important bearing, and that is with regard to the question of vegetation. We know that according to the peculiarities, climatic and otherwise of particular localities, the vegetation varies, inasmuch as the influence of the climate of India upon vegetation, particularly upon plants, roots, bulbs, and other things imported from England, is very remarkably seen. When we see this, I think we must make allowance for the influence exerted by the climate of India on the health of Europeans who have gone to reside in that country. It is a very common saying in England, and especially amongst those whose personal knowledge of the conditions to which they refer is limited, that the mortality amongst our people is, in the majority of cases, attributable to faults on the part of the people themselves ; it is due, they say, to too much eating or too much drinking. I am always glad when an opportunity occurs, such as the present, to try and show that such views are not correct. I have seen as much of European,—that is, British life in India as most people, and, although, of course, there is a good deal of mortality and sickness due to excesses there, just as there is here in England, still, the great difference in the rates of sickness and mortality there over the rates prevailing in Britain is to be accounted for by something else than mere excess ; and that something else is, I believe, to be found in those grave conditions, climatic and local, which we have not the means in the instruments at our disposal of identifying, and which affect vegetation in the way I have alluded to. (Hear, hear.) In order to make my meaning more clear, I may say that flowering plants—those, for instance, that have been introduced into India from England—completely change their characteristics ; that is to say, many of them so completely deteriorate in a year, or a couple of years, as not to be recognisable. Plants that are exceedingly productive in England in regard to seed, fail in that respect in India. Flowers and plants flowering or budding in spring do not bud or flower very often in some parts of India until the autumn, while in other parts they flower twice a year. Some trees, as, for instance, the ornamental trees that have been introduced from England, completely change their appearance and become unrecognisable ; and not only does this apply to trees taken from England, but also to those that have been introduced from Australia. I remember a gentleman from Australia going about with some of the officers in one part of India, and asking what a particular tree was. "Bless my heart," he said, "surely you

know that that is the *Acacia dealbata?*" The reply was, "It is so completely different in appearance from what the tree is in its native country that I really do not know it." When I take these things into account, as well as other facts resulting from the climate in regard to vegetation, I think it puts us in a better position to understand how people from this country should be similarly affected by the climate in India. Therefore, I hope the few remarks I have made will have some effect in leading my hearers to the belief that when our soldiers and officers come home pallid and ill from India, their sickness has been brought about by something more than mere excess. As long as we are able to maintain India, which I hope will be for many generations, this is a point to which I think we ought to look. The more we consider the great influence which the climate has upon organic nature generally, and the more we apply the observations that are thereby presented to us to our own case, the better we shall be able to consider this subject in its more rational and scientific aspect.

Surgeon-Major Park, R.A.—I should like to ask one question. I have not served in India myself, but I have seen a great deal of the British soldier, and his wife and children, and I should like to know whether there are any observations with regard to the effect of rainfall on the health and mortality of the soldier. From a personal experience of many parts of the world, excepting India, I feel strongly that he is a greatly belied man, and if such a Society as this can, by its publications, let the public have the views of such men as Dr. Gordon and Sir Joseph Fayrer as to the effects of the Indian climate on the soldier and his family, I think it will have a good effect. This may appear to be going somewhat wide of the subject of the paper, but I think the matter is one well worthy the attention of the English people. There is another point on which I should like to put a question to those who have served in India, and that is in reference to the common remark that three generations exhaust the vitality of the British residents in Lower Bengal. I wish to know whether there is any authentic record showing that this is the fact, or the reverse?

Dr. Chevers.—That proposition has been considered by all the medical men in India, not merely as to Lower Bengal, but throughout the country, except, perhaps, Simla and the high lands and hill sanitaria, which are modern places of European residence, scarcely occupied as such for more than fifty or sixty years, so that in their case there has not been room for observation. But with regard to other places which have been in a great measure inhabited by soldiers and their descendants, and where the invalids used to be allowed to retire and make themselves comfortable, it has nowhere been discovered by any medical man that there have been any genuine descendants, of unmixed blood, of any European family of the fourth generation—that is, assuming there has been no return to Europe for education and improvement of health. If an instance could have been cited I am sure one or other of our active inquirers would have certainly brought it forward.

Chairman.—In calling upon Sir Joseph Fayrer to make any comments upon what has been said, I would remark that the climatic conditions of life in India are interesting as affording us some means of judging what the condition of man might have been in past times in our own island. We may also learn therefrom facts which will enable us to draw valuable conclusions upon some geological questions. I will now call upon Sir Joseph Fayrer.

Sir Joseph Fayrer.—The first thing I have to say is that I thank those who have been good enough to speak so kindly of my paper. They have not raised any controversial question, so that really there is not much to reply to, and I need only refer to one or two observations that have been made. You, sir, have invited me to make some comments on what has been said, and first of all I would remind the meeting that this paper is essentially one on the rainfall of India. I included something about the climate, as it was necessary to do so: indeed I could hardly have avoided it in dealing with such a subject; but I did not include the whole scope of the science of meteorology. If I had attempted that—though the subject is one that is far beyond my powers—I should have occupied your attention, not for an hour only, but for many hours and many days. This will explain why I did not speak of the melting of the snows filling the rivers, and so on; and also why I did not go into such questions—about which I know very little—as the meteorology of Central Africa, though I should have liked to have heard more upon that subject from Colonel Grant. I will, however, notice one or two points that have been mentioned. Mr. Bateman spoke about the necessity for an equal distribution of water, and pointed out that heavy falls of rain take place in certain seasons and in certain localities, whilst it is dry in others. This, however is not the case to such an extent in our own country as it is in India; and I endeavoured in my paper to point out the great efforts that have been made, not only in the present day, but in past times, by those who preceded us in India, who were as much alive as ourselves to the necessity of supplying the wants of the country by irrigation, by digging wells, and by constructing reservoirs and canals. Of course there were great difficulties even then. In a country like the Deccan, or Southern India, which is a high tableland, sloping gently to the east, with the rivers running from west to east across the continent, there is plenty of water, but it is not available because the rivers cut such deep channels that they are beyond reach. Consequently, it is necessary to make great reservoirs by damming the water, and to cut the communicating canals for its distribution, of which I have spoken. This is a subject, the engineering aspect of which I know little; it is one on which General Maclagan could thoroughly enlighten you. Dr. Chevers gave you an amusing statement of my early initiation into meteorology. I may say that I might well have my attention attracted to the subject, considering that I spent my first year in a station where 600 inches of rain fell in six months, sometimes 30 or 40 inches in a day, filling the rain gauge so fast

that one had to look at it frequently to see that it did not run over; where the atmosphere was saturated with moisture and the heaviest thunder shower you have ever known in England, lasting only a few minutes, is there continued for days and nights without ceasing, sending down torrents of water that wash away every loose portion of earth on the plateau, and fall in great and magnificent cascades down to the plains below, which are very soon converted into a sea. Under such circumstances, it is not to be wondered at that one should have given some attention to the study of this subject. I was enthusiastic in those days. Going to Burmah, it seemed to me necessary that I should know something of meteorology. I therefore kept registers, and day by day for months I used to note the barometer, the thermometer, and the rainfall; and once every hour of the 24, *on term days*, which was by no means an easy task, as one felt very sleepy towards two or three o'clock in the morning. I am afraid, however, that those observations did not lead to much, unless they contributed something in the shape of an inducement to others to undertake the same kind of duty. I am happy to think that at the present time there is no department in India the working of which is more thoroughly organised than that of the meteorological department, under my old friend Mr. Blanford. In reading my paper I omitted certain paragraphs, because I thought I should have wearied you had I read them all; otherwise you would have noticed that I alluded to the value of Mr. Blanford's reports, which one can hardly extol too much, not only for the ability and science they display, as well as the perseverance and patience with which they have been worked out, but also for their prospective value, for I am quite satisfied they will yield excellent results in time to come; so that, whatever may have been the case in the past, we may for the future look forward with great satisfaction towards the culture of that branch of science in India. Dr. Chevers spoke on the important subject of the destruction of the forests and the use of wood on the railways. I have no doubt whatever that at the inception of the railway system in India much damage was done in this way, and I am afraid that some is done even now. The wood—not the forest trees so much as the smaller trees and the brushwood—used to be cut down to supply fuel for the lines of railway; but I believe that this is not the case now. As to railway sleepers, I do not think the forests we are concerned in are much indebted to them for their destruction, as the timber for this purpose comes chiefly from the great forests of that magnificent region where I have spent many happy months—the forest district at the foot of the Himalayas, where those magnificent trees, the sāl and the sissu grow. These are the valuable trees, especially the sāl, from which the sleepers I believe are made. Another speaker alluded to the importance of the effects produced by the melting of the snows upon the rivers. It is quite true that after the winter, when the great heat falls on the hill-sides and melts the snows, the rivers come down in floods, which no doubt help considerably towards the irrigation of the country, and even render a special arrangement of inunda-

tion canals necessary. Col. Grant spoke of the comparative smallness of the rainfall in Central Africa at certain elevations, which would seem to involve the necessity of a large rainfall, because in the equatorial regions, as I have already said, we have the great distillery of rain. But if you go into the centre of India, in the tropical regions within 15 degrees of the line, over 12 you find it to be very dry. These are the arid regions. You have the damp, moist wind, the monsoon, blowing from the equatorial regions, the reversal of the north-east trade, that would be blowing the other way, but for the distribution of land and water which disturbs the atmospheric equilibrium. These monsoons, on their first impact, on the ghâts which fringe the west coast of India, rising to a height of 3,000 or 4,000 feet—the height at which condensation most rapidly takes place—have the water squeezed out, and it falls in the shape of rain; while in the centre of the peninsula you have a dry table land almost under the shadow of the mountains that are squeezing out the rain. Old travellers noticed the phenomenon, but were unable to explain it. We understand how it is that those western ghâts condense the water out of the clouds and allow the air to pass dry over the other side. In that portion of the country south of Madras the atmosphere is comparatively dry, simply because the whole of the moisture has been squeezed out by the mountains it has passed over; one can readily understand how it may be that the portion of equatorial Africa referred to should be dry for similar reasons. I am not sufficiently acquainted with the physical geography of that part of the world to go beyond this; but I imagine the explanation may be something like that which I have given. Col. Grant's exploration of that part of the world has been so large that I feel sorry he did not give us more information on the subject. General Maclagan was very kind in his comments on my paper. Indeed, I felt some hesitation in reading it in his presence, for he knows more about the country than I do. He spoke of the distribution of rain. It is not that there is want of water, but difficulty in its distribution. We hear of terrible famines in India and the destruction of millions of lives, and we are led to suppose that this is occasioned by want of food. It is only a want of food in the famine districts. There is plenty of food produced in the country to supply the whole population if one could only distribute it. It is also important to remember that the country we are talking of, though it does not look very large on the map, is really equal in size to the whole of Europe, with the exception of Russia, and by this I mean the United Kingdom, France, Spain, Germany, Austria, Hungary, Italy, Sweden, Norway, Denmark, Greece, European Turkey, and more. Of course, the conditions are very varied in different portions of the country. As to the distribution of water, of which there is abundance at one season of the year and very little at another, while in some regions none at all, or scarcely any, it is made more or less available by irrigation; and it is owing to the particular department charged with this, of which General Maclagan is so distinguished a member, that the country is so well supplied with water, and will by-and-by be still

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better supplied than now. It is the officers of his service that have done so much to bring about the supply he has advocated. Dr. Gordon spoke on a very important subject, and as he did so it seemed to me how extensive was the question I had introduced ; I had contemplated only the rainfall, but I see now how many other things it leads to. My old friend and brother officer, Dr. Park, has also introduced a question of great interest, though hardly germane to the subject of the paper—the health of Europeans and their families in India. I merely touched on it because I thought it right not to pass it over altogether, for how could one deal with so large a subject, or do more than just touch upon it in the brief space at my disposal? The question of the continuance of the European race in India is a very important one, and as it has been discussed, I may say that my experience is the same as that of Dr. Chevers, and that I have never heard of an instance of the fourth generation of pure Europeans living in India. I have seen the third generation ; and I think, if anything were wanted to make one satisfied that the fourth could not thrive, it would be a sight of the third. I have nothing to add, except to thank you for the kind way in which you have listened to me.

The meeting was then adjourned.

ON PRESERVATION

OF

HEALTH IN INDIA

A Lecture

ADDRESSED TO THE ROYAL INDIAN ENGINEERING
COLLEGE AT COOPER'S HILL

BY

SIR JOSEPH FAYRER, K.C.S.I., LL.D., M.D., F.R.S.

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ON PRESERVATION

OF

HEALTH IN INDIA.

Gentlemen,—It having been intimated to me that some information about the climate, mode of living, diseases, and best method of preserving health in India would be acceptable to you in the form of a lecture, I have great pleasure in undertaking that duty, and will endeavour to impart to you some of the experience that I have gained in such matters during a long residence in that country, and which will, I trust, both interest and instruct you.

Colonel Chesney has made some important observations that I venture to quote as the text of what I am about to say in reference to the important question of health, and what you should do in India to preserve it.

He says,—" I have been very much struck with the amount of sickness to which our young engineers appear to be subject. A certain excess over the English average is of course to be expected in India, and engineers in particular are subject to exposure and malarious influence in an exceptional degree, but the number of cases of ill-health among these young men seems to be altogether beyond what might be set down reasonably to these causes. It is probably due, in part, to their being very much detached. A young officer on going to India joins his regiment, and learns from his brother officers how to take reasonable precautions. So the young civil servant gets the advantage of the example of his seniors at the station to which he is

posted. But the young engineer very often has no such guidance, and loses his health before he has learnt prudence.

"The matter is one of some importance. The accounts which have lately come home of sickness among them is really distressing. And more than one of them, in writing to us here, has deplored his want of a little elementary medical knowledge, not only on his own account, but from his inability to treat his work-people with the most simple remedies when out with them alone in the jungle."

I am aware that to gentlemen of your education and attainments much of what I shall say may seem trite and common-place, but as it is best for my purpose to do so, I shall assume that you are practically unacquainted with the subject, and treat it accordingly.

Few people, I imagine, who have not been there, appreciate the importance, or realise the vastness of British India. Let me remind you of some prominent facts relating to the country in which your future career is to be spent.

That extensive portion of the British dominions which gives to our Queen the title of Empress, and is called "the brightest jewel in her crown," is the great central and southern promontory of Asia, lying between the fifth and thirty-fourth parallel of north latitude, and the sixty-sixth and ninety-seventh meridians of east longitude. It includes a portion of Afghanistan in the north-west, and part of the country on the eastern side of the Bay of Bengal, extending from Chittagong to Tenasserim as far south as the tenth parallel of north latitude, and has a coast line extending for more than 4000 miles. It is about 1900 miles from Peshawur to Cape Comorin; and about the same distance from Sudya—a frontier post in Assam, to Kurrachee, at the mouth of the Indus; from Bombay to Point Palmyras in Orissa it is 900 miles. The superficial area is above 1,600,000 miles,—equal to the whole of Europe, excluding Russia, and three-fifths are directly under British rule.

The geographical boundaries are well defined, on the north by the Himalayas, a chain of stupendous mountains 150 miles in average breadth, the highest in the world, running north-west and south-east in a crescentic manner for 1600 miles, with a mean height of 16,000 to 20,000 feet; Mount Everest and Kinchinjunga, the loftiest peaks, being 29,000 and 28,000 feet above the sea level. This barrier, which separates India from Turkestan and Tibet, is crossed by passes 17,000 feet above the sea level, nearly as high as the line of eternal snow.

On the north-west it is bounded by the edge of the plateau of Afghanistan and Beloochistan, and by the Suliman and other mountain ranges; on the north-east by the heights of Assam, dividing the drainage of the Brahmaputra from that of the Irawaddy. It is separated from Burmah and Siam by the Youmadong and other mountains, whilst its coasts have the Bay of Bengal on the east, and the Indian Ocean and Arabian Sea on the west.

This extensive but compact country has nearly two hundred and fifty millions of inhabitants, composed of races more numerous and ethnically distinct, and speaking languages more numerous and varied than those of Europe; whilst, from the nature of its physical geography and the extent of its area, it has every kind of climate, varying from that of the Torrid to the Arctic zone. The seat of the most ancient civilization, with a history that reaches far back into remote antiquity; possessing a fertile soil, lofty mountains, elevated table-lands, rich alluvial valleys, extensive desert tracts, and plains; noble rivers, extensive swamps, jungles, and magnificent forests; a rich Fauna and Flora, wealth of mineral, vegetable, and animal products, and many undeveloped resources; it has characters that invest it with peculiar interest, especially for those who spend the best part of life there, and on whom the responsibility of ruling it has fallen.

A country with such physical characters has many distinguishing features of climate that are strange to the Anglo-Saxon, who has necessarily much to learn before he is acclimatised and adapted to his new home. The people

and their habits, the animal and vegetable creation, even the diseases, differ from those he has hitherto known, and he makes acquaintance—let us hope, not in his own person—with malarial and liver disease, insolation, dysentery, cholera, and others that at times sweep over the country as destructive epidemics, whilst the conditions of life generally under which he exists differ from those of more northern regions.

Such is to be your home and the scene of your labours; it is a field that has, as yet, been only partially explored, but which offers prospect of a rich return to those who work in it. Now, to enable you to take advantage of this, health is essential; but I regret to learn that of those who have already gone there, some have suffered, in this respect, beyond what may fairly be ascribed to climatic causes alone. It is on this account that I am here to-day, for the purpose of assuring you that health, though more precarious than at home, is not necessarily so seriously imperilled as you might suppose, if only ordinary precautions be taken,—to offer you, in short, some advice as to how you may preserve it, and avoid, or mitigate, whatever is injurious.

But as having an important hygienic bearing on the subject, let me first say a few words on the climate, seasons, and some other matters that affect the health of Europeans generally in India.

The Englishman has naturally a great power of adapting himself to altered conditions of existence—to extremes of temperature, and to climatic change. Like some of the domestic animals he has taken with him, he exists, nay, thrives, among the ice of the Polar regions, or under the vertical sun of the Torrid zone. This power of endurance is often severely tested, but the strain is sometimes due more to himself than to his surroundings, still there can be no question that, with care, it may be much enhanced. It is reported of an Irish soldier that he said, in reference to the evil effects of climate on his comrades—"They eat and they drink, and they drink and they eat, till they die, and then they write home and say it was the climate that killed

them." The soldier was not so far wrong in his estimate of the share climate takes, though he put it "more Hibernico."

In these days of expeditious travelling men are transported rapidly from one extreme to the other, the sudden change is itself a severe trial, and, if incautiously undertaken, may lay the foundation of a chronic intolerance of the climate. I shall never forget the suffering I endured on arriving in Calcutta in the end of April, when the thermometer was at 90° in a damp atmosphere, after leaving England in March in a snow-storm with frost on the ground. I have often endured great heat before and since, but never felt it as I did on that occasion, when physical and mental energy were alike depressed and almost prostrated by the sudden change. I do not know when the exigencies of the service may require you to go to India, but I would say that it is very desirable that Indian life should commence, if possible, in the cold season ; by so doing the prospects of tolerating the climate will be much increased. Let me say at once that a young Englishman starting with fair health, good habits, and freedom from tendency to organic disease, may live well and happily in India, find scope for the full development and exercise of his physical and intellectual energies, and return to England, after long service, able to enjoy life, and to work as well as others of his own age and, probably, not half his experience. But this will depend very much on how he has taken care of and adapted himself to the varying conditions of life in the tropics.

India, for our purpose in regard to climate, may be divided as follows: 1st, The Himalayan, with Bhotan, Nepal, Gurhwal, and Cashmere dividing it from the 2nd, or Hindostan, which extends along the foot of the Himalayan range, and includes the alluvial plains of the great rivers Brahmaputra, Ganges, and Indus, with their numerous tributaries, and part of Central India.

3d. Southern India, the Deccan—which consists of elevated plateaux, from 1500 to 3000 feet above the sea-level, littoral plains, intersected by numerous rivers, mountain ranges, and isolated hills; the Vindyah chain, covered with

forest vegetation, with its offset, the Satpoorahs, traverses the continent from the Eastern to the Western Ghauts (the latter rising from 5000 to 7000 feet), which bound it on either coast. The climates of this vast territory, correspond to latitude, elevation, and physical characters of the country. Northern India is extra tropical and less influenced than the Deccan by the periodic winds, which bring moisture more or less to the whole Peninsula.

The climates in which you may have to serve will, therefore, vary. In Northern India you may find yourself in one nearly as good as any in Europe; elsewhere, you may happen on that which seems barely compatible with life itself. Heat alone, however, is not the only objection, for almost everywhere there is added malaria, with whose effects all, sooner or later, are only too familiar. It is the cause of more sickness and invaliding than almost all other disease causes put together; and often never entirely ceases to manifest its effects on the constitution!—Life is maintained under more or less of a struggle, and I propose to show you how the contest may be successfully maintained.

The heat is also greatly modified by moisture, and the effects of a dry or a damp atmosphere at the same temperature are very different. Dry air in motion at the temperature of 100° is more tolerable than that at 75° or 80° when stagnant and loaded with moisture! The hot winds of Northern India are more endurable and often healthier than the cooler but saturated atmosphere of lower Bengal, or parts of Southern India. Varieties of climate need corresponding adaptation of modes of living, as you would sooner or later learn by experience; but I would have you prepared at once to frame your life in accordance with its surroundings.

The mean temperatures of the following stations are:—

Calcutta, 8 feet above sea-level, is in May (hottest month) 89°; January, 70°; but it ranges between 45° in the coldest, to 92° in the hottest months.

Madras, sea-level, June (hottest), 88°; January, 76°. Range, 72° to 92°.

Bombay, sea-level, May (hottest), 86°; January, 74°. Range moderate.

PESHAWAR, 1056 feet above sea-level. June and July (hottest), 91°. ; January, 52°. Range great.

PUNJAB, 900 feet above sea-level. June (hottest), 89°; January, 54°. Range, from frost to intense heat, 110° and more.

BANGALORE, 3000 feet above sea-level. May (hottest), 81°; January, 69°. Range moderate.

POONAH, 1089 feet above sea-level. May (hottest), 85° ; January, 72°.

BELGAUM, 2200 feet above sea-level. April (hottest), 81° ; May, 78° ; June, 75° ; December (coldest), 70°.

The coldest months are December and January ; the hottest, April, May, and June.

There are fluctuations in temperature owing to hot, dry winds, sea and mountain breezes, which give local peculiarities of climate ; but it may be said, generally, that there are three distinct seasons in India—the hot, the rainy, and the cold, which vary in duration and time of setting in; but approximately the cold season extends from November to March, the hot from March to June or July, and the rainy season from that to October or November. They do not pass abruptly into each other ; between each there is a transitional period.

The seasons are greatly influenced in their course and regularity, by the monsoons.

The south-west monsoon commences with storms of thunder and wind on the Malabar coast in May, and reaches regions further north later in the year. The Carnatic and Coromandel coast, sheltered by the Western Ghauts, is then exempt.

About Delhi and in the north-west it begins towards the end of June, and the rainfall is greatly diminished. In the Punjab, near the hills, the rainfall increases ; but in the Southern Punjab and in the great desert regions there is very little rainfall. There are belts or tracts of country commencing in Scinde and the N. W., with a rainfall varying from two inches up to some hundreds, the highest being at Cherra Poonjee, where 600 inches fall ; next to this the Western Ghauts have the greatest rainfall ; at Mahablesh-

war, 253 inches; on the Tenasserim coast it is 180 inches.

In places near the sea, where the land is low and the temperature high, very little rain falls, as at Kotah in Scinde, where it is only 1·8; or at Kurrachee, where it is 4·6 inches in the year. In inland districts, where the monsoon has lost much of its moisture, as at Peshawar only 13·8 inches fall. The rainfall in Calcutta is 56·8; in Madras, 50; in Bombay, 72·7; in Delhi, 25·1; in Meerut, 18; in Punjab, 56·6; in Benares, 37; in Bellary, 21·7; in Bangalore, 35; in Poonah, 27·6; in Belgaum, 51·5; in Kamptee, 21·8.

The amount of humidity in the air varies greatly. Flat hot plains like Scinde, where there is little or no rain, have an atmosphere almost saturated. Some of the lower mountain ranges, Bengal and many districts near the coast in Southern India, are very damp. The elevated table-lands of the Deccan and Central India, and the hot sandy plains of North-West India, have a dry air, and during the months of May and June, in the latter, it blows like a furnace blast, being heated and desiccated by the hot plains over which it has passed.

The north-east monsoon commences in October, and is attended with dry weather throughout the peninsula generally, except on the Coromandel coast, where it brings rain from the Bay of Bengal, over which it blows, between October and December.

In the hill stations of Darjeeling, Missoori, Nainee-tal, Murree, Simla, and generally in the elevated provinces of the lower ranges of the Himalayas, also at Ootacamund, Conoor, Wellington, Mahabaleshwar, in the Neilgherries and Ghauts, stations at elevations of five to seven thousand feet, Europeans enjoy a climate as genial and healthy in summer, and almost as bracing in winter, as in Europe. These are favourite health resorts, and will probably become the sites of future colonization, for it seems probable that there the European will thrive and continue to reproduce his race; while, it is said, that after the third generation his progeny would cease to exist in the plains.

The meteorological conditions and physical characters I have described influence the seasons as follows :—

In Bengal the cold season begins about the middle of October—the days are hot, but the mornings and evenings are cool. The wind is northerly, the air is dry and bracing, the sky bright, though still there may be cloudy days, and occasional showers—the last traces of the monsoon. In November and December the weather is cooler, the north-east wind is fresh and sharp, and the air dry ; there are heavy dews at night, dense fogs are apt to prevail, the thermometer ranging from 56° to 78°. About Christmas a few showers occasionally fall. January is colder, the air is bright and keen, fogs are frequent ; one may be out all day in the open air, but it is always necessary to protect the head against the sun's rays. The thermometer falls to 46° or lower, and rises to 75° or 76°. Until the middle of February the weather is delightful, but it then begins to get warm at mid-day. During these months the climate is most agreeable, and those who have been in camp will tell you that nowhere is there a more healthful and delightful season. It is strengthening to the system exhausted by heat and moisture ; the appetite and strength return, and the frame becomes reinvigorated and elastic—but there is risk of visceral congestion, thoracic complaints, bronchitis, etc.

In March, the hot weather sets in. The sun is powerful, though the nights are still cool. Atmospheric disturbances, called north-westers, with heavy showers, now cool and freshen the air, and are sometimes accompanied by thunder and hail. Thermometer ranges from 70° to 85°, or higher. In April and May the weather becomes intensely hot, but there are occasional showers and storms, that relieve the oppressive state of the air, which is generally hot and muggy—so damp as to prevent evaporation—the skin becomes clammy with perspiration, and irritable from the eruption of prickly heat. The thermometer ranges from 80° to 90°, or higher. The weather is intolerably oppressive, and at nights so close that it is difficult to sleep. The constitution becomes irritable, the nervous system depressed; weakly persons, and

especially those who are of intemperate or irregular habits, suffer severely, and not unfrequently succumb to heat, apoplexy, or asphyxia.

There is tendency to fevers and liver complaints. In the commencement of the hot season—February and March—cholera is apt to appear in Calcutta, and what is called the endemic area in Bengal, where, perhaps never quite extinct, its visitations are then most severe. Towards the end of May rain often falls, and is known as the "Chota Bursat," or lesser rains; but frequently the hot muggy weather continues to June without rain till about the middle of the month, when the south-west monsoon sets in with thunder storms and heavy showers, settling down into heavy rains, which bring the much-longed-for relief, and clothe the earth with verdure; the air is now cooler but saturated with moisture; this continues until October, when the rain abates; the winds become variable, and during, if not before, September, rain ceases; the air is very damp and oppressive, and it is at this season that the European constitution suffers most—depressed by the previous heat and damp, it is more than ever oppressed by the hot steamy atmosphere in this unhealthy season, when malarious diseases, hepatitis, dysentery, fever, spleen, boils, and other torments are apt to occur. During the drying up of the moisture malaria is evolved and active; the vital powers are low and the constitution is readily affected by it.

In the north-west and Punjab the same sequence is observed, but modified by latitude and physical characters of the country. The winter is colder and prolonged into spring, but the sun is powerful, the air dry and bracing, and life in the open air is pleasant. The rains are later, and in some tracts are very scanty, while the hot winds in May and June are so intense that the thermometer will rise to 110° or higher in the shade, and were it not for the effect of perspiration in cooling the body, life would often be in danger. Indeed, natives as well as Europeans succumb to the Loo-marna (hot wind stroke), as it is called in Hindoostanee. Barring this direct action of great heat, however, it is not unhealthy, and with care a high state of health may be preserved.

The heat must be mitigated by the punkah, or tempered during the hot winds by the tattie and thermantidote.

In Southern India the climate varies with the peculiar features of physical conformation. The sea coasts below the Western Ghauts are hot, wet, and steamy; the elevated plateaux are dry or moist according to their proximity to the Western Ghauts. The Carnatic is hot and dry. The thermometer at Madras ranges from 72° to 92° or higher. The delightful cold of Bengal and Northern India is unknown there. The ordinary diseases of the tropics prevail, and liver disease is nearly twice as frequent as in other parts of India. One great compensation, however, it has in its sea breezes and the proximity to the delightful climate of the Neilgherry hills.

Bombay is a hot, steamy place, built on a muddy, unhealthy site; but it has been improved, like Calcutta, by sanitary works, whilst its proximity to the elevated plateau of the Deccan, and hill stations, its charming scenery, and the sea, make it a favourite place of residence.

Such is a brief sketch of some of the physical characters of India, and of its climate and seasons. This was necessary as introductory to the question of health, to which I now pass on.

We have now to consider how you are to guard yourselves against adverse influences, so as to obviate the deleterious action of the climate, and preserve health; how to act in case of disease occurring to yourselves or others, where medical assistance is not immediately available. The difficulties against which you will have to contend will be chiefly those due to extremes of temperature, dryness, moisture, and miasmata. Heat and cold are relative terms, and you are likely to suffer from cold in a hot climate, especially if it be a variable one. The power of tolerating climatic influences is great, if care be taken to observe simple hygienic rules.—Avoid exposure to obvious causes of disease; attend to the nature of the food, drink, clothing, lodging, moderate exercise, work, and recreation, and submit to the moral and physical self-discipline that preserves mind and body in a state of just equilibrium. When I am

asked, as I often am, how a young man should live with the view to preserve his health in India, my advice is that he should live temperately in all things, always wear flannel next his person, avoid exposure to the direct rays of the sun, and notoriously miasmatic localities. Go to bed and rise early; eat moderately, and at regular hours; smoke and drink as little as possible; and guard against giving way to passion, excitement, or the irritability of temper so easily acquired in hot climates. Check immediately all tendency to bowel complaint or other acute symptoms. Avoid idleness, and its consequent ennui, on the one hand; and over-work, mental or physical, on the other. Let him do this, and he may hope to enjoy health, and serve out his time with advantage to himself and the service.

I have already alluded to the importance of beginning life in India in the cold season. From October to February, or even March, is the best time; but the earlier the better, for at all other seasons the Red Sea and the Indian Ocean are so oppressive, that you might arrive in India with the seeds of mischief already sown. I do not say it is *impossible* to go during the hot, but that it is better to do so in the cold, season.

Suppose, then, that you have arrived in India in good health, and at the best season of the year—that you are placed in an isolated position, where you have only yourself to rely on, and no one from whom to seek counsel or aid. Your first enemy will be the sun, which even during the winter months has great power. Avoid exposure to it as much as possible after the early morning and before the evening hours. Never go out without a good hat made of solah (pith) or other light material, and envelop it with a puggrie. The head, temples, back of the neck, and spine, should be protected. If you have to be out in the sun in the hot months, protect the spine by a pad of cotton or cork, 4 or 5 inches broad and 12 or 14 inches in length. It is well, also, to have an umbrella, which should be covered with white calico to make it more impervious to the sun's rays. During the very hot hours of the day, some green leaves, or a light pad inside the hat;

wetting the puggrie or even the hair, will add to the protection against the heat. Your clothing should be light, but not too light, as a certain amount of substance is desirable to keep out the heat; and light woollen or cotton is the best material. One point I would particularly urge as *most* important: it is, never, under any circumstances, omit to wear flannel or light woollen under-clothing. I regard this as a point of cardinal importance, and never to be disregarded. Understand that the object of wearing it is not to keep you warm, but to equalise temperature, and prevent chills. During the action of the skin, the body clothing, if of cotton or linen, becomes wet with perspiration, and the first draught of air that brings it in contact with the skin causes a chill, and the evils that may follow are numerous. An extra precaution, sometimes of great value, is the so-called cholera-belt, a band of flannel worn round the abdomen to protect the abdominal viscera from sudden changes of temperature. In many parts of Northern India the cold of winter is severe, and the warmest English clothing will barely protect you. Young men in the vigour of health are apt to neglect and despise these precautions, but I assure you that, as matters of personal hygiene, their importance cannot be over-estimated, as a few minutes' exposure of the head to a hot sun, the laying aside of underclothing because it is hot at night, may lay the foundation of serious mischief.

Exposure to the direct solar heat, or to a high temperature in the shade, may induce heat asphyxia, sunstroke, ardent fever, or other evils of a more insidious character, by injuring the nervous system, increasing irritability, depressing vital energy, and affecting the internal organs, especially the liver, which has already extra work, in eliminating waste products, and in compensating for the diminished respiratory excretion of carbonic acid through the lungs, the consequence of breathing a more rarified and therefore less oxygenated atmosphere.

The blood becomes deteriorated, there is a tendency to liver affections, fever, boils, and a variety of ailments, and the general health fails. All are not so affected, for many live for

years apparently uninjured by the heat ; but as a rule the European does at length become debilitated, and needs change to a cooler climate, which he should take, if he can, after six or seven years. Stimulating or rich food, and alcoholic drinks, should be avoided, or taken in extreme moderation, and the punkah, thermantidote, or tattie should be resorted to. Ventilation of dwellings, and especially of sleeping rooms, should be attended to ; and, if possible, the latter should be raised above the ground level. It may seem paradoxical to say so, but cold is more to be dreaded at this time than heat, for chills and draughts are most pernicious, and one is never more prone to suffer from them than when bathed in perspiration. A current of air, or the fall of temperature from any cause, and above all, the neglect of woollen under-clothing, may give rise to chill, and fever, liver, dysentery, diarrhœa, or rheumatism may be the result. I have known serious illnesses caused by sleeping in a draught, or in the cold air coming from a thermantidote, or from the sudden chill caused by the punkah pulled suddenly after it had been stopped by the coolie falling asleep. It is well to sleep in a light flannel suit, in order to protect yourself from such chills. In the great heat, people sometimes endeavour to get rest by sleeping in the open air, but this is a dangerous practice, unless in very dry climates, and should be deprecated. The punkah is an indispensable apparatus ; it consists of a frame-work of wood and canvas, with a fringe which is swung backwards and forwards from the ceiling by a rope passing over a pulley, and drawn by a coolie ; by putting the air in motion it communicates a feeling of coolness that is very grateful, and indeed, without it in some parts of India, the heat would hardly be endurable.

The thermantidote is a machine through which, by the rotation of a wheel and fans, a current of cooled air is drawn into the room; and with the tattie, which is a frame filled with khus-khus, a fragrant grass, is much used in the dryer parts of India, where the rapid evaporation of the water sprinkled on the grass, produces a great fall in the temperature. For example, in May, in Oude, with a hot

west wind, the thermometer stood in shade 104°, in house 83°; behind the tattie 68°.

The direct action of the sun, or of a very high temperature in a damp atmosphere, whether by day or night, in some cases causes very dangerous symptoms, as I have already stated, often resulting, after partial recovery, in permanent injury to the cerebro-spinal system. Those, especially, who are debilitated or intemperate, are in danger, as is often sadly illustrated in the hot oppressive nights of May and June in close rooms, in railway carriages, and the like, in Bengal and other parts of India. In the dryer atmosphere, where the natural refrigerating powers of the body are lowered by disease or intemperance, many succumb during the hot winds, though less frequently in the case of those who live carefully and take ordinary precautions.

With regard to diet, I have only to say that it should be plain and simple: for new arrivals it is better to abstain from *much* animal or stimulating food, with the view of avoiding plethora, dyspepsia, mal-assimilation and congestion of the already overtaxed liver and eliminating organs. Whilst enjoining moderation, I do not mean that I advise you to copy the natives of the country entirely in their food: you cannot altogether change your mode of living or the character of your aliment. Your stomach will no more obtain from the diet of a Hindoo all that is necessary for nutrition, though it may contain it, than it could in other circumstances from the blubber that delights whilst it nourishes an Esquimo. Habit, in these things, becomes hereditary, and our machinery is not adapted for sudden changes. But the principle is sound, and the food should be modified to suit it to changed circumstances.

As a general rule, people eat too much in India—more than they can assimilate, or is needed for nutrition. The consequence is, disordered digestion, faulty assimilation, disordered liver, bowel complaints, and the presence of effete matter in excess in the blood. Take a cup of tea before your morning ride or walk if you will; a plain breakfast of tea, coffee, bread and butter, eggs, or even a

bit of chicken, at 9 or 10 (you really do not need more than the bread and butter); lunch or tiffin at 1 or 2 P.M., with very little animal food, a cutlet or leg of a fowl, with vegetables, will suffice, and a glass of light wine or bitter beer if you really feel that you must take some stimulant, though, I firmly believe, that, for young men, it is unnecessary. People generally dine in the evening; so will you probably. This will be the principal meal of the day; see that it be a judicious one—the simpler and plainer the dishes the better. The good old maxim of "leave off with an appetite" you will do well to observe. It would detain me too long to discuss particular articles of food—that may well be left to your discretion; but I would impress on you the importance of the physiological reasons for being abstemious. As to wine, beer, and spirits, I would say that, freely admitting there may be circumstances in which they are required, and recognizing the fact that a certain quantity is taken with pleasure, and even benefit, by some, it is, at the best, an acquired want that does not originally exist in healthy young men (and you have no business to go to India if you are not healthy), and that, whatever may be said on other grounds, it is not *a necessity.* If you can abstain from alcoholic stimulants, excepting when they are prescribed by the physician, I am as certain that your chances of living and thriving in India will be greatly enhanced, as that I am telling you so! Supposing, however, that you cannot, or will not, abstain, I advise you to prefer light wine, such as claret, to beer, beer to spirits. Avoid the last as much and as long as possible. Brandy and soda water is called a "peg" in India—some one said because each one was equivalent to a peg in the coffin. This is taking a sensational view of the subject, but there is a substratum of truth in it. You see I am not an advocate of stimulants, outside of medicine, and I believe that I am right. I have little faith or sympathy with the common excuse of bad water: it is not as a rule made better by mixing it with alcohol. I would repeat, if you really need a stimulant, let it be of the simplest and purest kind, and never, under *any pretext,* take it *before lunch.*

As to smoking. It may be pleasant, but it is unnecessary. To many, in moderation, it does no injury; but what is moderation? It often injures the nervous system, interferes with digestion, depresses the mental as well as the physical, and muddles the intellectual powers. If you *must* smoke, let it be the mildest tobacco, and as seldom as possible—only after eating, and never in the morning or till after lunch. This view about alcohol and tobacco will not, perhaps, meet general approval, but I undertook to tell you what is good for you and not what is merely agreeable. They are not always synonymous. These are matters that I have studied for many years. I have heard all the arguments on either side, have made my own observations and some experiments, and what I have told you is the result.

The drinking water is a matter of great importance, and attention to obtaining it in a state of purity is a prominent hygienic duty. Its impurity is the reputed cause of many diseases, and probably none is more potent for evil. A variety of complaints—cholera, fevers, diarrhœa, dysentery, goitre, and some others, including certain parasitic diseases, with which the human race may be affected—are ascribed to it. Water should always be filtered, and it is well to boil it; heat dissipates certain impurities, and tends to render others innocuous. An ordinary sand or charcoal filter is therefore a desirable addition to your household furniture. The sources of water supply are wells, tanks, rivers, and rain; wherever you take it you should ascertain its probable freedom from contamination by organic impurities before you drink it. Ærated drinks are not always free from impurities, for the water of which they are manufactured may not have been either filtered or boiled.—Take note of turbidity, smell, taste, as these indicate the possible nature of substances with which water may be impregnated. I cannot go into the subject of analysis, but I may just say that you should submit it to the following simple tests:—It should be free from smell and ought to be soft, dissolving soap easily; if not, there are too many lime salts present in it. It should be clear,

sparkling, and colourless; if it is not so, you may improve it by boiling, filtering, and allowing the sediment to settle. Sediment will be deposited by the addition of a little alum, or other astringent. Boiling destroys the activity of organic matter, and the ova of most of the lower forms of life. It deposits lime salts and so diminishes the hardness. A green tinge suggests the presence of vegetable matter, not necessarily dangerous; a yellow tinge, sewage contamination or peaty matter, sometimes iron—the first dangerous, the latter two not so. It is firmly believed by the natives that the standing water of pools, jheels, swamps, and tanks in the forests, the Terai, and malarious localities, are charged with fever poison in solution, and it is not impossible that they may be right. Always avoid such water, however thirsty you may be; at all events, never drink it till it has been boiled and filtered. Water may be contaminated by lead or other mineral poison, but you are hardly likely to meet with this impurity. Iced water is much drunk in India; the ice comes from America, or is artificially made. You may drink it with impunity. I have no recollection of seeing any one suffer from drinking iced water in a hot climate. Indeed, in the great heat it is good, for it tends to keep down the body temperature.

Filters are simply made with charcoal or sand, but they require frequent cleansing from the organic and other impurities they collect.

The use of water externally is of the greatest importance in hot climates, for cleanliness and for keeping the action of the skin free and unimpeded. Generally, cold bathing in the morning is best, but you must be guided by its effects: if it causes a pleasant glow and reaction, it agrees with you; if it depresses or makes you chilly, use it tepid, or you may bring on congestion of the lungs, liver, spleen, or other internal organ. Generally it will be found to invigorate, and nothing is more refreshing than a mussuck or gurrah of cold water poured over the head and body, either in the early morning or when you come in from a hard day's work, marching, shooting, riding, surveying, or

the like. The swimming bath is also very good—many stations have them. You may bathe in lakes or other still water, or even rivers, but not in the heat of the day; only be sure there are no alligators, leeches, or other noxious creatures to hurt you. Too much bathing should be avoided, and the temperature of the bath must be suited to the idiosyncracy of each individual. The hot bath will often give great relief in feverish states or other conditions of indisposition, but avoid it as a daily habit if you can.

As regards your dwelling, you should select one on a raised site, well drained, ventilated, and as far as possible from low, damp, or swampy ground. Bungalows are one-storied buildings, not always constructed with much regard to sanitary requirements, but are frequently the only houses you can obtain. When you *can* get one with a second storey, always do so, and sleep upstairs. Your room should be large—1800 cubic feet is the smallest space consistent with a due supply of air, and it is better to have much more; see that it has the proper amount of door and window space, but avoid draughts and currents of air. At nights, however great the heat, you should have a light blanket to draw over you, and it is well to wear night-clothing of light flannel or cotton. The punkah is necessary during hot nights—without it sleep is often impossible. It is very important that you should have good sleep, for nothing in the hot weather more refreshes or invigorates you! Early rising is the rule in India, and I advise you to conform to the usual practice. The morning is the time for exercise and fresh air, and you will do well to devote an hour or so to walking or riding. Exercise is essential to health, and you should make it a duty to obtain it. The use of the Indian clubs, which you may soon learn from the natives, is a good supplement to other exercise; it developes the chest and gives vigour to the muscular system. Exercise prevents langour and inactivity, keeps away liver congestion and dyspepsia. Do not overdo it, especially during the great heat, as over-fatigue and exhaustion may predispose you to disease. Let me advise you also to exercise your minds as well as your bodies. Intellectual torpor and stag-

nation are as much to be dreaded as physical, and nothing is so likely to keep you out of irregular habits as mental occupation. Your duties will pretty fully employ you, and you will not have been long in India ere you find that most men have as much, if not more, to do than they can thoroughly do justice to. But you are not always to be on duty, and it is right that you should have some resource in intellectual exercise and amusement. You will have little difficulty in getting books, and it will add to your happiness and well-being if you read them, and also if you study the native languages, and cultivate any accomplishment, such as music or drawing. For my own part I can say that I always found time for something beyond my mere professional work, and I can safely add few were more fully occupied. But I did more in the way of reading and research when in the full swing of my professional work in Calcutta than I ever did at any other period of my life. The habit of work grows, and one learns to utilize every spare moment. Physical health is so much influenced by, indeed, I may say dependent on, mental health, that the integrity of one often implies that of the other.

Depend on it that he who leads a well-regulated and fully-occupied life, and who submits to self-discipline, is the healthiest and happiest man. I would caution you against giving way to the insidious growth of irregular habits—the more dangerous that you had probably no original desire for them. If not on your guard, you may find that, unconsciously, they have obtained an ascendancy exceedingly difficult to get free from.

I have said nothing, I trust, that will tend to make you over solicitous about yourselves. A proper amount of precaution is right, but coddling and anticipating disease is much to be deprecated. Nothing is worse for a man in unhealthy places or in times of epidemic disease than a state of nervous expectancy and apprehension,—it is as unwholesome as it is unmanly. Keep your minds cool and collected, observe the ordinary rules for preserving health, avoid exposure to direct causes of disease, and leave the rest to Providence; but be careful about conservancy, see that all

bath-room refuse and discharges of disease are carefully removed. Do not imagine every headache is sunstroke or apoplexy, every pain in your stomach cholera or dysentery, every twinge in your side liver. Most frequently such things are merely transient disturbances, and pass away. Neither frighten nor physic yourself into real disease. There is no greater mistake than to be always dosing for imaginary or even for real complaints ; and there are sufficient real causes for anxiety without worrying yourselves about imaginary ones. Having given you some idea of how you should avoid disease, I must now say a few words on the diseases themselves, and tell you what you can do in emergency for yourselves or others until you can obtain medical aid. But it is impossible in the time at my disposal to do more than give you a few general principles.

Few pass a year in India without learning what fever is, and that there are several forms of the disease. There is simple febricula, that lasts for a few days and passes away, perhaps never to return, without doing any injury. Its symptoms are malaise disordered secretions, headache, muscular pains and weakness, loss of appetite ; it may be due to the first effects of heat on a constitution not inured to it, to irregularities of diet, and quite probably to malaria. The treatment is simple. Remain at home—take a dose of aperient medicine, cooling drinks, and a light diet ; saline diaphoretics during the hot stage, a few grains of quinine after it has passed away. If it do not pass away in a few days it will require other management. No one knows what malaria *is*, but most people in India know what it *does*. I fear one must admit that no part of India is quite exempt, though many are worse than others. Heat, moisture, vegetable matter, and its putrefactive changes, certain soils or geological formations, seem to determine the thing or the condition, whichever it is, that causes ague or intermittent and remittent fever.

The miasm is most pernicious in certain districts, and where there is dense vegetation, such as the Terai, it gives rise to what is called jungle fever. Marshes, swamps, and submontane belts of forest, or low jungle, where the subsoil

water lies near the surface, such as the Himalayan Terai (I wish I had time to tell you more about it), are often deadly and uninhabitable for a great part of the year; the worst season everywhere being in the drying up months, when heat is dessicating the ground, and liberating malaria. Dry arid tracts of land are not exempt, for it is bad enough in many districts where it cannot be attributed to surface moisture—but it may be that subsoil damp is the cause. I may say, in passing, that there is no more fertile source of disease than subsoil water and imperfect drainage. It would appear that cultivation and living on the ground will in time improve its salubrity, but beware of newly-disturbed ground, or of clearance of vegetation, for there emanations may arise, from which the most pernicious malarial fever may result. You have an example of the consequences of bad surface drainage, improper distribution, or retention of water, in the fever that has been for years depopulating a district (Burdwan) in Bengal. There is a grand field for engineering skill and science in the sanitary arrangements of India, and I commend it to your consideration. Malarial miasmata are influenced by locality, winds, heat, &c. One is more liable to suffer on the leeside of a swamp, for example, than to windward of it. A belt of trees intervening will protect to a certain extent, and a covering of the slightest gauze, such as a musquito curtain, will guard the sleeper at night. It is more potent near the ground than at an elevation, hence you should always sleep in an upper storey, or in a bed well raised from the ground, if you can get one. People constantly exposed to malaria become to a certain extent inured to it; but ague or fever are not the only modes in which malaria declares its action. Broken health, anæmia, cachexia, enlarged spleen, neuralgia, are even more frequent results, and it often happens that persons may be driven away by ill health from malarious districts who have never had fever, though they may have suffered severely in other ways. Such persons not unfrequently get fever after they leave the district and return to Europe. In cases of malarious anæmia, with enlarged spleen,—a common result of fever,—

a mixture of quinine gr. iij., and sulphate of iron gr. ii., taken two or three times a-day, for some weeks (keeping the bowels regular), will be of benefit, but nothing more imperatively than this demands change of climate. The fever caused by malaria is known as intermittent, because it comes at intervals in a paroxysmal form, with a cold, a hot, and a sweating stage, according to the intervals at which these recur it is quotidian, tertian, quartan, or it may come at irregular and longer intervals.

These distinct intervals are rather the exception than the rule in India. The form it assumes appears to depend on the intensity of the poison and the peculiarity of the constitution, and perhaps of the locality. In some cases it becomes what is called remittent, and in others, assuming a more severe aspect, it passes into a condition like that of typhus, and is very dangerous. These are the forms generally known as jungle fever.

The treatment is that of ordinary fever; in the first stage—salines, and after the hot stage has passed away, five to ten grain doses of quinine every fourth hour, which should be continued for sometime, until the physiological effect of the drug is produced, as recognized by deafness and singing in the ears. It is well to take a dose an hour or so before the paroxysm is expected, for it may prevent it altogether. —It is impossible to dwell longer on this now, for I have still much to say on other matters.

There are other forms of fever—the enteric, which may, like the disease in Europe, be due to specific contagion from drains, sewers, or the like, or it may be a form of climatic disease;—the true typhus, and the relapsing fever. But these, I fear, it is quite impossible to enable you to deal with, in a few brief remarks,—though, generally, I may say a modification of the treatment I have already mentioned would be desirable, to support the strength and allay fever.

Another complaint that you may be called on to deal with is dysentery, known by the intense pain and difficulty with which the bowels act, and the passage of mucus and blood.

This should at once be treated with 15 or 20 grains

of ipecacuanha in water, and repeating it in three or four hours for three or four times. This, if done early, will nearly always give relief and arrest mischief. Avoid all solid food. Afterwards take Dover's powder, 5 or 6 grains, twice or thrice a day, with 2 or 3 grains of quinine ; use hot fomentations ; keep perfectly at rest in bed, and, if possible, communicate with the nearest medical officer. Any sudden relaxation of the bowels should at once be arrested by a dose of astringent medicine and ten drops of laudanum. It may be that it was really not necessary to do this, and you may have to correct the effects by a dose of castor oil afterwards ; but diarrhœa sometimes means incipient cholera, and it is an error, if one at all, on the right side, to check it. Cholera is recognised by the vomiting and purging of watery fluid, which goes on rapidly, and soon exhausts the patient ; cramps and lividity soon set in, and death may result in a few hours. On the first symptom of diarrhœa give laudanum x. to xx., or chlorodyne xv. to xxx. drops, and repeat in two or three hours if necessary, or give cholera medicine frequently, as directed. Apply turpentine stupes, or mustard poultice, to the abdomen ; give champagne or brandy and iced water, and endeavour to support the courage and the strength of the patient; keep him warm, rub the limbs and body with ginger powder. Send for the nearest doctor without delay. In times of cholera prevalence it is well to avoid taking aperients, especially salines ; be careful not to eat unripe fruit or indigestible matter ; be particular about purity of the water. Avoid over fatigue or any exhausting work, and keep your mind as free from despondency and alarm as possible. At once check any diarrhœa, and avoid all food or drink that might tend to increase or to cause it, and be very careful that all cholera discharges are removed, disinfected, or destroyed, and prevented from having access to the water.

A propos of malaria and exposure to heat, I may here say a few words on shooting and hunting, during which you are likely enough to be exposed to the risks of both. Snipe shooting has much to answer for ; it is a common form of sport, and easily obtained im many parts of India. Avoid

it in the heat of the day, and altogether in notoriously malarious localities, and when you do indulge, change your wet dress after you come out of the swamp as quickly as possible, and on no account sit down to tiffin in your wet clothes. Drink as little as possible, and I recommend you to adopt cold tea as your beverage. When you are shooting in jungly and swampy malarious places, it is well to take 3 or 4 grains of quinine and some food before you start. In shooting from the howdah or on foot in the hot weather, which is the time for tiger and big-game shooting, carefully protect your head and spine, smoke little, and keep to cold tea. Heavy tiffins, with beer, champagne, brandy and soda, and rich dishes, are as destructive of sport as they are of health. If you will take these precautions you may endure heat, and exposure with a fair chance of escaping mischief. The exercise is good for you, and the pursuit of big game is not only most interesting, but it helps to develop your physical and mental energies.

A few words about exposure to heat and its effects. It may cause faintness or exhaustion, or more serious effects on the brain and nervous system, inducing excitement, unconsciousness, and if very severe, death. In the event of an attack, remove the person into the shade, loosen all tight dress, and apply cold water to the head; if he be pale and faint, a dash or two of cold water, it may be, will rouse; if the prostration be profound, that, or a stimulant may do good, but it should be administered with caution; quiet rest and the recumbent posture will soon restore, but the sufferer should be taken home, and not exposed again to the heat. If the face be flushed and the skin hot, apply cold water and ice, if you have got it, over the head and body, remove him to a cool place, administer an aperient, and keep the bowels open. Perfect rest and quiet should be secured, and if recovery is not complete and rapid, send for medical aid. An intense form of fever, with head symptoms, may be the result, which requires active and prompt treatment of the nature I before described to you in reference to ordinary fever. Of course this is but the merest outline of what you should do, but this much, if done promptly, will be

of great service, and may save life. One thing I may caution you against—it is that you should never in such cases attempt to bleed the sufferer. Your remedies are ice to the head, cold affusion, perfect rest and quiet in the coolest shelter you can find.

A few words about liver disease, which begins most probably by pain in the right side and shoulder, fever, nausea, constipation, and a semi-jaundiced skin. Free purgation, with a calomel pill, compound jalap powder, or sulphate of magnesia, fomentations over the side, and very spare diet, excluding meat and alcohol, will probably give relief, and may stave off inflammation and consequent abscess. If the case is severe, seek the nearest medical aid. For ordinary bilious derangements, with foul tongue, nausea, sallow face, eyes tinged with bile, a couple of colocynth pills, and a dose of salts next morning, with abstinence from animal food and stimulants, and avoiding exposure to heat, will remove it; but beware of any mode of life that may appear to tend to increase the disposition to these attacks, for they may end in congestion—perhaps inflammation of the liver. As to diarrhœa—if it occur when you are otherwise in good health, and if you think it may be due to any indiscretion in diet—take a dose of oil, or of Gregory's powder, to expel the peccant matter, keep to a light diet for a few days, and all will be well. Diarrhœa *may* be the precursor of an attack of cholera; if that disease is about, check it at once, for reasons formerly given; if from other causes, simple astringents, such as chalk and catechu, with restricted diet, may be sufficient to remove it. Chronic diarrhœa of the tropics requires change of climate and treatment that I cannot describe here.

In connection with functional derangement of the liver, I would call your attention, having been asked to do so, to a condition which not unfrequently depends on it, often amounts to serious disease, and is always a source of trouble and annoyance to the sufferer. I refer to hæmorrhoids (piles). These are vascular growths (small tumours) connected with the mucous membrane of the lower bowel, either within the orifice, or just external to it. They are of

two kinds, the internal and external, and depend on a distended, congested, and varicose state of the hæmorrholida blood vessels and mucous membrane, and are much influenced by the condition of the liver, as the vessels implicated form part of the so-called portal circulations, by which is meant the blood that, flowing through certain veins, enters a large trunk called "Portal," the branches of which are distributed to the liver; the blood brought by it being that from which bile and other products are separated. In certain abnormal states of the liver in which the free circulation of the blood is impeded, congestion of these vessels is apt to result, and to give rise to this troublesome affection.

Whilst small and incipient, they are comparatively harmless, but when they increase in size, as they are apt to do, and when they give rise to mucous discharge and hæmorrhage, from rupture of the distended vessels, they are prejudicial, and should be removed or otherwise actively treated.

The *internal* are generally the most troublesome, but both are liable to fits of congestion, inflammation, and at times, hæmorrhage.

The loss of a small quantity of blood in this way is often attended with a delusive sense of relief, and the sufferer feels better for it; but this cannot go on long without causing serious mischief to the health. It is best to try and avoid having the affection at all, and the way to do so is to keep the bowels regular, avoid luxurious and slothful habits, take plenty of exercise and a moderate diet, bathe the parts with cold water, and avoid excess of food and stimulants of all kinds.

I trust none of you suffer in this way, or have any tendency so to suffer, but if you do, that you will not go to India, until relieved. A sedentary life may have induced it, if so get rid of it before going to a hot climate, where the complaint is likely to increase. I have already cautioned you, in respect of food and drink, in regard to the well-being of the liver—the same precautions apply for similar reasons in this case.

Lead regular lives, avoid excesses of all kinds, take regular exercise, and keep the bowels open.

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In case either external or internal piles should have proceeded so far as to cause pain or hæmorrhage, then rest is imperative ; saline aperients should be taken ; cold and astringent applications or injection may be required ; apply tannic acid or alum in water, or an ointment made of gall nuts ; but as soon as possible repair to the nearest medical officer for aid. When the swelling and tension are severe, hot fomentations with solution of acetate of lead and opium may give relief.

The frequent losses of blood, even in small quantities, are very prejudicial; they cause anæmia and debility, a blanched and pallid appearance, with breathlessness and exhaustion. They should never be allowed to continue ; and it is most probable that an operation for their removal will be necessary. You should lose no time in seeking medical aid. When from any cause, such as errors of diet or stimulants, cold or wet, the piles become inflamed, you should take a dose of calomel, gr. iii., opii gr. i., and follow it with a dose of castor oil next morning. Foment, and keep on your couch for a time.

If the pain and tension are very severe, a leech or two, or puncture of the distended tumour, may be expedient. But in such cases, if possible, get medical aid.

For those who have a tendency to the affection, careful living, plain food, regular exercise, the use of some mild laxative, such as confection of pepper, and senna or Ward's paste, sulphur and cream of tartar, rhubarb with ipecacuanha and soda, may be very useful, and the application of the gall ointment already mentioned. The use of the enema of cold water every morning after the action of the bowels is often of great service.

These precautions, necessary everywhere, are especially so in hot tropical and malarious climates, where there is a natural tendency to liver derangement, and therefore I have offered these few remarks as especially applicable to those who are to live in India, and because I received a hint that they might be specially useful.

Of course there are many other diseases and accidents to which people in India are liable. I have only been able to

mention those that most specially call for notice, and it would be quite impossible for me to do more in the brief opportunity afforded by one lecture.

I must add a few words on snake bites, musquitos, centipedes, scorpions, &c.

The order Ophidia has three divisions : O. colubriformes, innocuous ; O. colubriformes venenosi, and O. viperiformes, venomous.

The poison apparatus of a snake consists of a gland, situated in the temporal region, which secretes a clear, slightly viscid fluid, that is poured through a duct into a grooved fang situated on a movable maxillary bone, capable of erection and reclination, to a greater extent in viperine than in colubriform snakes, by the action of muscles which push forward the maxillary bones, raise the fang, at the same time compress the gland, eject the poison through the duct into the groove in the fang, and thus hypodermically inject it into the bitten part.

The fangs are longer, more curved, more movable, and more formidable in viperine than in colubrine snakes—they are deciduous, and when lost by accident or shed are quickly replaced by reserve fangs that lie loose in a fold of mucous membrane.

Viperine snakes can recline or erect each fang independently of the other. This power is limited in colubrine snakes. The poison is secreted in considerable quantities ; half a drachm may be collected from a fresh and vigorous cobra. It is very deadly in its action, probably more active in some snakes, quantity for quantity, than in others, and varying in activity in the same species or individual, according to season, temperature, state of health, etc. It acts most rapidly when injected into the blood ; but it can be absorbed through mucous and serous membranes, as seen by its poisonous effects when applied to the eye, the stomach, the peritoneum. It may neither be applied to the lips nor taken into the stomach with impunity, and sucking a snake bite is by no means free from danger, though if the saliva be quickly ejected and the mouth washed, the danger is diminished. It contains an active principle, and is very

nearly like albumen in composition. It is most active on warm-blooded creatures, but it takes effect in all. Poisonous snakes are very insensible to the venom of other species of poisonous snakes. A cobra or viper is not poisoned by another cobra or viper's venom, though probably affected by that of other species. But all other living creatures succumb to it.

The action of the poison is local and general.

Local.—Pain, partial paralysis of the bitten part, ecchymosis, swelling, and if death does not rapidly follow, infiltration of other and distant parts, cellulitis, sloughing.

General.—Depression, fainting, nausea, vomiting, hurried respiration, exhaustion, lethargy, paralysis, loss of consciousness, hæmorrhagic discharges, coma, convulsions, death. If the quantity of poison injected be small or its nature feeble, the symptoms may give way and recovery take place. Snake poison acts by paralyzing the nerve centres—sometimes the peripheral distribution of the nerves, and by altering the constitution of the blood. It takes effect through the circulation, and if inserted into a large vein it will cause almost instant death.

There is reason to believe that the numerous agents that have been recommended as antidotes are useless, and have no such properties as those ascribed to them.

The rational treatment of snake poisoning is the endeavour to prevent the entry of the virus into the circulation, to support the failing nerve force, and to aid elimination.

There is often uncertainty as to the kind of snake, its condition, and the extent to which its fangs were used. The shock or depression which follows a snake bite may be in a measure due to fright, and will, on reassurance, pass away. The marks of two well-defined punctures attest the insertion of two fangs, and if the snake has not been seen, may enable one to form an opinion as to its character. Many of the innocuous snakes are fierce, and bite vigorously, but their numerous teeth leave different marks to those of the poison fangs.

A few innocent snakes have the anterior maxillary teeth developed like poison fangs, but bites from them are not very likely to occur.

It may be well to note some of the characters that distinguish the venomous snakes. The form and arrangement of their teeth, and an examination of the mouth, will always reveal the true character. In the mouth of a venomous colubrine snake, such as cobra or bungarus, two well-developed fangs will be observed, one on either side, and close behind it there may be seen one or two smaller teeth ; there is no row of teeth along the outer side of the mouth, but a double row will be found on the palatine surface.

In the viperine and crotaline snakes, a large fang will be found on either side, and a double palatine row. There are no small fixed teeth behind the fangs as in colubrines, but in a fold of mucous membrane at the base of the fangs, both in vipers and colubrines, a set of loose reserve fangs will be found.

In Hydrophidæ the fangs are arranged like those of the cobra, but are very minute, and no reliance can be placed on any mark made by them—bites very rare.

Harmless snakes have a double row of equal or nearly equal-sized teeth in the maxillary and palatine bones.

There is nothing (except the hood in Najadæ) in colubrine snakes peculiarly characteristic of their venomous character ; at first sight it is difficult to say whether they are poisonous or not. Indeed, several of the innocent have a more repulsive aspect than poisonous species.

The viperine and crotaline snakes are remarkable for their broad arrow-shaped heads, often without shields, their thick bodies, and short tails. They have thick, swollen-looking lips, from the large fangs underneath them ; and the nasal pits in Crotalidæ are very conspicuous. The Hydrophidæ are recognised by their compressed bodies and tails. Their peculiar heads, which in some species is very small, the valvular nostrils, and the absence, except in one genus, Platurus, of ventral scales. They are obviously aquatic, and are always found in the sea or washed up on the shore. Space will not admit of more than a general indication of the genera and geographical distribution.

These belong to the families Elapidæ, Hydrophidæ,

Viperidæ, Crotalidæ. Elapidæ is a large group, widely spread over India. It contains the truly venomous snakes, such as ophiophagus, naja, bungarus.

Family HYDROPHIDÆ.—These are sea snakes, and probably all very poisonous. They have a wide range of distribution in the Indian and Australian seas, from Madagascar west to Panama east.

Genera.—*Hydrophis* has numerous species, and probably many yet undescribed. They are found in the Indian seas about Formosa, and in Australia. *Platurus:* 2 species; Bay of Bengal. *Enhydrina:* 1 species; Bay of Bengal. *Pelamis:* 1 species; Indian and all Eastern Seas.

Family VIPERIDÆ.—The daboia of India and Ceylon, echis of India, are deadly vipers.

Family CROTALIDÆ.—The pit vipers. Trimeresurus, several species, in India, Ceylon. They are poisonous, but not nearly so much so as are the vipers. Peltopelor, Hypnale. Halys, in Himalayas. These are not very poisonous; though they may cause severe symptoms, are hardly able to destroy life.

Snake bites are very dangerous in India, but happily are very uncommon in Europeans, though twenty thousand natives die yearly from this cause. The venomous snakes of India are the ophiophagus, cobra, bungarus (black or steel coloured, and yellow-banded) Russell's viper, and echis carinata. There are also some others comparatively rare, and the salt-water snakes, which are all poisonous. The cobra, the krait, the Russell's viper, and the echis viper are the snakes most likely to be met with, and their bites are very deadly. I will quote some remarks that I have made elsewhere on this subject, and some general instruction how to treat the bites.

As soon as possible after a person is bitten by a snake, apply a ligature, made of a piece of cord, round the limb or part at about two or three inches above the bite. Introduce a piece of stick, or other lever, between the cord and the part, and by twisting tighten the ligature to the utmost. Apply two or three ligatures above the first one at intervals of four or six inches, and tighten them also.

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After the ligature has been applied, scarify by cutting across the puncture to the depth of a quarter of an inch with a penknife or other cutting instrument, and let the wounds bleed freely, or better still, excise the punctured part. Apply either a hot iron or live coal to the bottom of these wounds as quickly as possible, or some carbolic or nitric acid. If the bite be not on a finger or toe, or a part where a ligature could be applied, raise up the integument with the finger and thumb, and with a sharp penknife cut out a circular piece as big as a finger nail round each puncture, *i.e.*, round the points of your finger and thumb, to the depth of a quarter or half an inch. Then apply the hot iron to the bottom of the wounds. Give fifteen drops of liquid ammonia diluted with water immediately, and repeat it every quarter of an hour for three or four doses, or longer, if symptoms of poisoning appear ; or give hot brandy, or other spirit, with an equal quantity of water, about an ounce of each (for an adult) at the same intervals. Should no symptoms of poisoning appear in half-an-hour after the application of the ligatures, they should be relaxed or the part will perish from gangrene ; if they should appear, the ligatures should not be relaxed until the person be recovering from the poison or until the ligatured part be cold and livid.

Suction of the wounds may be beneficial, but as it may be dangerous to the operator, it cannot be enjoined as a duty. If, notwithstanding, symptoms of poisoning set in and increase, if the patient becomes faint or depressed, unconscious, nauseated, or sick, apply mustard poultices or liquid ammonia on a cloth, over the stomach and heart, continue the stimulants, and keep him warm, but do not shut him up in a hot stifling room or small native hut; rather leave him in the fresh air than do this. Do not make him walk about if weary or depressed, rouse him with stimulants, mustard poultices, or ammonia, but let him rest. If the person be first seen some time after the bite has been inflicted, and symptoms of poisoning are present, the same measures are to be resorted to. They are less likely to be successful, but nothing else can be

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done. In many cases the prostration is due to fear; the bite may have been that of a harmless or exhausted snake, and persons thus bitten will rapidly recover under the use of the above measures. If poisoned, but, as is frequently the case, not fatally, these measures are also the most expedient; if severely poisoned, no others are likely to be more efficacious. People should be warned against incantations, popular antidotes, and loss of time in seeking for aid. The measures suggested are no doubt severe, and not such as under other circumstances should be entrusted to non-professional persons; but the alternative is so dreadful that, even at the risk of unskilful treatment, it is better that the patient should have this chance of recovery.

Protect yourselves from musquitos by using a curtain,—you are sure to be bitten pretty freely at first, and I hardly know of any remedy. The irritation may be allayed by a cooling lotion of goulard; the application of sal-volatile and eau de cologne may give relief; and it is said that camphor, penny royal, and lemon juice, if rubbed on the skin will keep them away—which is best of all.

Centipede and scorpion poisoning are comparatively rare. The pain is severe, and in an unhealthy state of the constitution it might be dangerous; but generally a cooling lotion—ipecacuanha or ammonia, applied externally, seem to neutralize the action, and allay pain. There are many other things that I might have said to you had time permitted. I have selected that which seemed to me most important, and may, I hope, have some effect in directing your attention to the means of preserving health, which, I repeat, there is every reason to hope will be preserved if you will only, from the date of your arrival in India, observe certain precautions and rules which, though simple enough, are very important. I have placed before you specimens of the clothing and head-dress, and other things that I recommend you to wear. Two valuable works on Domestic and Bazaar Medicines, by Dr Moore of Bombay, and Dr Waring of Madras; also a work on Snake Poisoning, by Dr Ewart, I recommend to you as part of your travelling library; and also a medicine chest of a simple and portable form, pre-

pared by that eminent pharmaceutist, Mr Squire, which would enable you to meet sudden emergencies. Of course I cannot pretend to direct you further than this, but with such hints as I have thrown out, and the simple instructions accompanying the drugs, you may be able to relieve suffering or save life until you can get further aid.

I am conscious that I have detained you too long, and, I fear, exhausted your patience, but trust what I have said may be of use ; so it only remains for me, in conclusion, to wish you a long and prosperous career in the great country we have been discussing, and to which, as I think, most who have served there, look back with pleasure and satisfaction.

THE END.

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MALARIA.

By Sir JOSEPH FAYRER, K.C.S.I., M.D., F.R.S.
Read before the Epidemiological Society

(*Read: Feb. 1st,* 1882.)

The subject of the following communication was suggested by some allusions made by Dr. Ewart in his paper last month, and by remarks offered in reference to them, in the discussion that followed.

The question raised was the old and still unanswered one, What is Malaria?

It is not with any hope or intention of supplying the information we so much desire, that I address you, but, that after referring briefly to the present state of our knowledge, I would invite such discussion as may elicit your views and gather from your experience something that may throw light on this obscure subject. It is one that has often been discussed in speech and in writing, but I doubt if ever it has been presented to an assembly better qualified than this, by experience and knowledge of every kind, to do it justice, and to put before the world such facts and explanations as may clear away the doubts that now surround it. I know I am addressing men who have had the largest opportunity of witnessing the operations of malaria, who have studied the subject practically as well as by the light of rapidly advancing knowledge of micro-pathology, and who are capable, from every point of view, in which such a subject can be studied, of investigating and revealing its nature and characters. Therefore, I venture to place it before you for discussion as one, than which there can be none more appropriate for your consideration.

What do we mean by this term, which is so familiar everywhere, and here especially? one that means so much, and yet conveys so little. The Italian word is of comparatively recent origin, and is not the one in popular use in Italy either, for there they talk of the "Cattiva-aria", though that of course means precisely the same thing, and is the popular, as distinguished from the scientific, term.

It was in Rome, about two hundred years ago, that Lancisi first pointed out the connection of agues with marshes and their emanations, and called them fevers, and the exhalations

producing them, "paludal"—as they still are called. In Rome again, a successor of Lancisi traces the connection of ague with the marshes, but this time it is not to an exhalation, but an organism, which he and his co-worker Klebs call Bacillus malariæ. Which is nearer the truth, Lancisi or Crudelli, remains to be proved; but of this more presently. Laveran has recently discovered another micro-organism in Algeria, which he thinks is the *vera causa.*

Malaria, whatever it may be, manifests itself, and is best known by its influence on man—and animals too, as I am informed by Profs. Axe and Fleming (though this is often disputed), over a great portion of the earth's surface. It has no defined geographical limits, but practically may be said not to pass the isothermal line 65° north, and 30° south latitude; and not to appear when the diurnal range of temperature is below 60° Fahr. It becomes more intense and active, generally, approaching and within the tropics.

It is very much regarded as a tropical evil, and so indeed it is, but not by any means exclusively so, for it is found all over Europe, in the south especially; and the Campagna of Rome, the Pontine marshes, the banks of the Danube, the fens of Holland, the rocks of Greece and Gibraltar, all maintain an evil celebrity.

In nearly all continental Europe there are malarious regions; Spain, Italy, France, Germany, Greece—even our own country is not exempt. Once we were a very suffering people, and lost two kings, a queen, cardinal, a lord protector, and many other great people, from a disease that is now almost unknown, at all events in its severe forms, though it still lingers in some districts of the south and east of England. Why this change? It comes of better drainage, better houses, better food, better personal and general hygiene, and therefore it is full of encouragement for other countries; and are we not now profiting by this experience, and thus gradually diminishing disease everywhere? Dr. Chevers, who for years has taught the Government and people of India how they might preserve their lives and health, will tell you that, by degrees, it is being recognised and shown that people need not die as fast as they did, even in India, and as we have reduced the mortality of soldiers, who are under control, from 60 to 16 per 1,000, from 13 to 3 of fever alone, so we may do, and indeed are doing, much more still; but how much remains to be done! About 3,500,000 natives die yearly in India of fevers. No doubt registration is still imperfect, though they are doing all that is possible to improve it, and deserve immense credit for what they have done,

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and very probably 50 per cent. of these who die do not die of malarial fevers but of thoracic complaints, and others with a hot skin. Still, if one and a half million of people die of undoubted malarial fever, to say nothing of the other one and a half million, and of thousands who perish from dysentery, diarrhœa and other complaints, such as cholera according to some, etiologically linked with this class of malarial fevers, is it not prodigious? The great cause of this mortality is the unknown thing or condition or group of conditions, called malaria. Some call it climatic influences, sudden alternations of temperature, chill only. But is this the case? Can a chill, or can any agency irrespective of something ingested or inhaled produce such effects? Hippocrates and his predecessors probably knew that people who lived near marshes got intermittent fevers, but they did not know of malaria, or think of fevers and paludal exhalations, in connection with each other, as cause and effect. It was Lancisi who first attributed fevers to marsh exhalations. Agues, remittents, pernicious, masked fever, and other paludal cachexiæ have long been known, but they are not worse in the Tropics than they are now, or have been in Europe in past times. Read Pringle's valuable work, Lind, Ferguson, MacCulloch, and others of that time and at a subsequent date; or go back further, and read Lancisi and Sydenham, and you will see that not the coast of Guinea or the Nepaul Terai can give you anything much worse than Europe did in those times, and could do now under certain conditions we hope never to be revived. Read Pringle's account of the state of the army in Flanders, or even in Scotland before and after Culloden, and you will understand that tropical fevers differ more in intensity than in kind from fevers in temperate climates. Clarke says, that in Calcutta in 1780, about 80,000 natives and 1,500 Europeans died of fever annually. In 1880, 3,797 died, all told, of fevers, chiefly malarial.*

* *Prevalence of Fever and Causes.*—The registered deaths from all causes in India in the year 1879 were 4,975,042.

Cholera accounting for	270,552
Small-pox accounting for	194,708
Bowel complaints accounting for	250,173
Fevers accounting for (out of a population of 187,105,833)	3,564,035

Civil Population, Fever Deaths.

1877	2,504,493
1878	3,247,371
1879	3,564,035

or thirteen times as much as cholera; though it may probably fairly be

What then is the nature and *raison d'être* of this mysterious agent, so destructive to our race and yet so amenable to sanitary interference, and which all over the world, under certain atmospheric and telluric conditions, produces so much

estimated that not more than 50 per cent. of these deaths are due to endemic fevers.[1] In the case of certain classes subject to registration, the figures are reliable; those relating to the general population are probably less trustworthy, but still sufficiently accurate to give a tolerably correct idea of the prevalence of disease and extent of mortality.

Let us look at the statistics of fever-prevalence as illustrated by the sanitary reports and returns of hospitals in Calcutta.

The mortality from "fevers" in Calcutta has been, during six years:

1875	5,328	1878	6.186
1876	4,361	1879	4,796
1877	5,151	1880	3,797

Clarke says that in 1770, 80,000 natives and 1,500 Europeans died from fever in the city of Calcutta.

The British army in India in 1879 numbered 57,810 men; of these 51,959 suffered from fever, with a mortality of 387.[2] The Native army,

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[1] In the present state of registration it is not possible to define the special character and type of these fevers. They are certainly, for the most part, malarial in character. Attempts have often been made to arrive at the actual number of true fever-deaths, and they all agree in showing that fatal diseases attended by heat of skin and other febrile characters are returned as fevers. In the Chanda district, out of 1,008 deaths, the Civil Surgeon found that 672, or 66.6 per 100, were due to fevers properly so called. The Civil Surgeon of Betul reports that out of 208 deaths 66, or 31 per cent., were fever deaths, and so on. The Civil Surgeon of Mandla states that from personal inspection he has ascertained that fever forms 7.5 per cent. of the mortality. The Civil Surgeon of Wardah gave the following result of personal inquiry into the cause of 69 reported fever-deaths.

18 died of remittent fever.	2 died of pleurisy.
9 died of bronchitis.	2 died of peritonitis.
8 died of ague.	3 died of vermes.
3 died of continued fever.	

Suppose 50 per cent. die of fever, the loss of life is great.

[2] The mortality of the British troops in the Bengal Army during sixteen years, 1830 to 1845, gave a ratio of 13.25 per 1,000 from all fevers.

The same for 1875 was only 2.77 per 1,000.
,, 1876 ,, 2.46 ,,
,, 1877 ,, 2.21 ,,

In 1878-79 there was more fever from the famine and Afghan War. These three years appear to be normal.

Army of all India for five years, 1871-75:—

Deaths from all fevers, 1875 = 2.81 per 1,000.
,, ,, 1876 = 2.41 ,,
,, ,, 1877 = 2.16 ,,
,, ,, 1878 = 5.07 ,,
,, ,, 1879 = 6.55 ,,

The rates for 1878-79 were part of the great fever epidemic which swept over India and occasioned enormous losses to the civil population. The rates include the Afghan fever and those on the march of troops.

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disease and mortality that it has been called the destroying angel, whose mission it is to keep the population of the world in check; producing disease too of a peculiar type, and having the power of establishing a diathetic condition in

of 130,011 men, had 122,375 cases of fever with 756 deaths. The jail population, of 117,680 persons, had 73,484 cases of fever with 1,306 deaths. 1879 was an unusually unhealthy year, epidemic fevers of a malarial type were prevalent and fatal. In some districts, during and after the close of the rains and beginning of the cold season, the mortality was very high. In Bolundshur and Allyghur the deaths rose to about 113 per 1,000 of population, the mortality from all causes being but little in excess of that of fever alone [1]

The population of Bengal, under registration, in 1880 was 59,890,237; about 4 per cent. located in towns, 96 per cent. in country and villages. The deaths registered in the whole province were :—

Cholera	39,643
Small-pox	22,953
Fevers	689,605
Bowel complaints	44,969
Injuries	22,339
All other causes	103,124
Total registered deaths	922,633

Fevers destroyed nearly three times as many as all other death-causes put together.

BOMBAY.

Seasons.	Registered Fever Deaths.	
	1880.	Mean of 14 years.
Cold	93,800	63,446
Hot and dry	38,488	28,304
Rainy	73,746	62,992
Hot and damp	40,745	38,773
Total	246,779	193,515

The Deaths for each month being

January	24,689	July	18,922
February	22,625	August	19,856
March	23,921	September	18,396
April	19,901	October	18,406
May	18,579	November	22,339
June	16,572	December	22,565

The seasonal prevalence (*vide* Table) shows how cold and variable

[1] "The unusual rise in the fever mortality was marked in August and September, was at its height in October and November, and then gradually declined" (*Sanitary Commissioners' Report* for 1879, page 78). The Sanitary Commissioner of the North-West Provinces remarks :—"Everywhere the rise, culmination, and decline happen at the same time, and as from a cause co-existent everywhere in the Province. This cause was malaria, and it is attributed to excessive rainfall following two years of comparative drought" (*Sanitary Commissioners' Report* in 1879, page 78).

those who have been exposed to its influences that shall affect them for the rest of life, and reproduce on the banks of the Thames that which was inaugurated half a century before on the shores of the Hoogly, the Indus, or the Congo?

Marsh miasm and marsh malaria are inappropriate names, however, for a disease-cause that is often generated where there are no marshes, and which is often as active in its manifestations on sandy, rocky, arid ground as in swamps. It has been shown over and over again, that the desert plains of north-west India, as well as arid regions in other countries, where there is no apparent surface water, and little or no vegetation—such as on the granite rock of Mount Aboo, on the magnesian lime-stone of Kurachee, the Island of Ascension, Rock of Gibraltar, and other similar localities—these fevers of a periodic type abound, and that a soldier may come away as fever-stricken from Peshawar as from the Soonderbunds. No part of the 1,600,000 square miles of India seems to be quite exempt, except perhaps the higher hill stations, and even they are doubtful; it is thought by some that above 3,000 to 5,000 feet it is absent, but this is a mere approximation. It is the fashion to speak of malarial and non-malarial localities, but in India, in the sense of producing fever, all are malarial. If there be one thing of which, by evidence, we are more convinced than another, it is that somehow water-logged land, *i.e.* land where the subsoil water is near the surface and stagnant, is the chief determining cause. The surface may be dry as it was at Walcheren, but if it be porous, and the air can get at the stagnant water, with perhaps ever so little organic matter below, and if there be a temperature above 60° Fahrenheit, then the state of things, or the thing itself we call malaria, may occur. This seems to be proved by what occurs in the Doab, between the Ganges and Jumna, and in other districts where irrigation canals bring in more water than is needed for the wants of agriculture; the land becomes water-logged, and in the absence of drainage, the fevers pre-

temperatures affect the etiology of these fevers. The contrasted mortality between that of the hot and dry, and the rainy and damp seasons shows the effects of added moisture on the amount of fatality. The fevers in these returns are all placed under one general heading—the types comprehended being the malarial and continued. Among them, no doubt, are included deaths due to other inflammatory disorders, such as pneumonia; whilst, on the other hand, not a few of the deaths from dysentery and diarrhœa belong more properly to malarial fevers. Registration is rapidly improving, but is not yet perfect.

vail in a degree unsurpassed by any part of the country, except perhaps in the Terai.*

For example: The population of the North-west Provinces and Oude in 1881 was 44,107,061; the deaths from fever amounted to 987,220, nearly a million. The death-rate in the Terai was nearly 53.41; in Roy Bareilly 21.72. The irrigated districts of the Doab, which come next, are nearly as bad as the Terai, and we have had, for some years, opportunity of watching the effects of subsoil water in excess in producing fever in the province of Burdwan, in Bengal, which became simply water-logged by arresting

* *The Sanitary Commissioners' Report* of December 31, 1880, contains much information in respect of the prevalence of fever, the causes of malaria, and the influence of irrigation on fevers. This province includes the pestilential Terai and the Doab, an irrigated area which was scarcely less unhealthy.

Population of Oude and North-West Provinces, 44,107,061 in census of 1881. The registered deaths for five years, including the period of scarcity, was :—

Years.	Total Deaths.	Deaths per 1,000 population.
1876	937,490	21.94
1877	840,538	19.67
1878	1,521,724	35.65
1879	1,914,499	44.81
1880	1,281,155	29.99

The improvement in 1880 follows relief from scarcity. The lowest death-rate in 1880 was 21.72 in Rai Bareilly. The highest in the Terai 53.41. The chief death-causes in 1880 :—

Diseases.	Total Deaths.	Deaths per 1,000.
Cholera	71,546	1.67
Small-pox	8,240	0.19
Fevers	987,220	23.11
Bowel complaints	80,312	1.88
Injuries	20,553	0.48
All other causes	113,284	2.65

About twenty-three out of every twenty-nine deaths were due to fever. The mortality caused by small-pox, cholera, and dysentery, is nothing in comparison with that from fever. Nearly a million of people (987,220) died in 1880 of malarial diseases. The liability to fever here seems to have been increased by other predisposing causes, the most important being under-feeding; but as this was not the case with the entire population, and as they were not all badly clothed and housed, though all suffered, it is evident that there were other causes in operation.

The Sanitary Commissioners' Report for 1879 shows that the general causes which influenced the public health in fever localities, were undrained ground into which canal-water had been led, and rainfall added to the already water-logged subsoil. In 1880, food became cheaper, and except in certain districts there was less rain. In 1879, during the great scarcity of food, the fever death-rate was 37.82 per 1,000; in 1880, it fell

or altering the natural course of streams and interfering with subsoil drainage. It was nearly depopulated by a low form of fever, call it malarial, typho-malarial, or what you will. Certainly the greatest weight of evidence seems to support the theory of stagnant subsoil water, and organic matter at a certain temperature, as the cause. But the subsoil water must be STAGNANT to make it dangerous. When it moves, as it often does, ever so little, it is no longer so detrimental. Some would exclude the necessity for organic matter at all, considering moisture and earth to be sufficient without it; this may be so. Others think, or suggest, that animal, combined with vegetable organic matter, may have peculiar effects, according to the relative quantity of each. What tropical marsh exhales vegetable decomposition alone? It

with increase of food to 23.11 per 1,000, which was still above the five years' average of 20.91 per 1,000.

The monthly fever mortality for the whole registration area was:—

North-West Provinces, 1880.

Months.	Fever Deaths.	Months.	Fever Deaths.
January	116,366	July	56,502
February	72,030	August	74,127
March	69,250	September ...	87,618
April	72,534	October	91,248
May	76,622	November	99,459
June	78,200	December	93,264
Total	485,002	Total	502,218

The total annual deaths from fever, taken through the scarcity period were:—

1877	574,722	1879	1,616,108
1878	982,117	1880	987,220

The fundamental cause of the great loss of life from fever, was increased predisposition from scarcity of food. Cold, damp, and alterations of temperature in the latter half of the year, and dampness of soil, the result of irrigation throwing more water into the subsoil than was needed by growing crops. This must have acted as a serious predisposing cause.

The chief engineer was of opinion that the fever is *not* due to irrigation, but to great diurnal range of temperature, chills, and imperfect feeding. He says:—"Without the great diurnal range, canal irrigation will not produce malarial fever;" but, he admits, that under these climatic influences it may do so, especially in the winter months, and thinks that better clothing and food would protect the people. But we know that these fevers occur irrespective of changes of temperature, though, no doubt, they have much influence in re-exciting it in those who have previously suffered, but not *de novo*. Fever occurs in every month of the year, though more in some seasons than others. With the excessive mortality in irrigation districts, the conclusion is inevitable that the true cause is stagnant subsoil water. The remedy for all this is better drainage, whilst no more water should be used than is required for the crops.

must be mingled with the miasmata of decaying animal life of low forms.

If malaria be a miasm, an exhalation, is it one, or are there many? Does the same thing produce fatal remittent fever and slight malaise? Is one, only the result of concentration, the other of dilution, of the poison? Is the malaria of a granite rock, or of a sandy arid plain like Sinde, or parts of Spain, the same as that of a marsh, or a mangrove swamp? How does it differ from that of a rubbish-filled tank, dry ditch, moat, drain, cesspool, pond, tank, some upturned earth, mud, or soil, exposed to the light and air after a jungle has been cut down, the bilge of a ship, etc., etc.? MacCulloch says malaria comes from every pond, ditch, hole, coppice, wet grass, or ground in England, and that the malaise is experienced by those who live in damp houses in the neighbourhood of ponds, or which are surrounded by moats, and so on; or even a flower-pot, a watered flower-bed, is only different in degree from that which strikes a man down in an algid pernicious fever, or coats his tongue and teeth with sordes like that of typhus.

All these are questions unanswered, but such as must suggest themselves to those who have had to deal with the matter practically, as well as to those who only deal with it statistically. No one has seen or found any tangible or particulate thing as yet that can be relied on. I come to Klebs, Crudelli, and Laveran presently, "La terre est riante et fertile, une fraîcheur délicieuse vous repose le soir des chaleurs brûlantes du jour—et tout cela c'est la mort." You remember the description of the "cattiva aria", in the Villa Borghese, by Madame de Stael. Chemists have done their best; many foreign matters have been detected, gases, organic matter, and so on, but none of these is the malaria. The Italians have lent us two words—malaria and influenza—both expressive of much, yet descriptive of nothing. Influenza is more vague even than malaria, for it deals with a more complete abstraction. If an impression made through the cerebro-spinal and vaso-motor system from without by heat, cold, electricity, or from within by an emotion, or in any other way by which the body may be affected, can produce acute catarrhal, bronchial, intestinal, febrile, or nervous symptoms, why may not such a cause explain the phenomena ascribed now to malaria, as an entity, *i.e.*, a gas or a germ?

Some such view is held by highly experienced men at present, and was in past times by others. Read what Ferguson said last century; what Drs. Gordon, A. Smith, Moore, Oldham, and

others say now. There certainly is much in the character of Indian fevers to support these views, which are eminently deserving of consideration. For my own part, I must say that I cannot feel convinced that merely climatic influences, alternations of temperature, abstraction of heat, can account for a tertian or remittent fever. There must be, I think, a "tertium quid", but I do not know what it is. Chills, cold, and damp will reproduce ague in one who has suffered before, or will develop it in those who have lived in a so-called malarious country, though they never had fever when there; but it will neither cause fever *de novo*, nor that peculiar cachexia with which many of us are so familiar.* Now, whether this subtle addition is a chemical molecule, or an organic germ; an emanation, or a bacillus; or whether it is only the outcome of the forces which surround us, and of certain external influences acting on the cerebro-spinal centres, and producing certain nutritive changes, and perhaps developing an autogenetic poison, is the question which needs solution.

The interesting researches of Klebs, Crudelli, Laveran, and their Italian and French followers, as Dr. Henderson told us not long ago, in a very able summary of the most recent researches into this branch of science, are the latest attempts to define malaria. According to Klebs and Crudelli, bacillus† seems to be at the root of this as of so many other evils; if so, what a monster he is despite his littleness! Think of a microscopic rod causing half the mortality in the world! People thought badly enough of the cobra for slaying 20,000; the bacillus slays his millions yearly. But does it really do all this? Is it really the *teterrima causa?* Is all the periodic fever, dysentery, some would say cholera, diarrhœa, cachexia, spleen, beri-beri, etc., due to this microphite? Dr. Sternberg, who has repeated Klebs and Crudelli's experiments with great care, says that he does not deny the possible connection of fever with bacillus, but the causal relation is not yet proved. Still the weight of evidence at present seems to be in favour of the bacillus; but think of all it will have to explain.

Those who have lived in India or other malarial countries and dealt with malarial diseases, and have seen the extraordinary caprices and results ascribed to malaria, will find it hard to explain on this basis. For my own part, I am not

* The great tendency now-a-days is to trace all disease to a specific cause, but we must not lose sight of the possibility of causes developed in the body, and altered conditions of the nerve-centres and vaso-motor action, and so on, by forces influencing from without.

† According to Laveran, a ciliated corpuscle.

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convinced. But I am convinced that we are infinitely indebted to those who are working out these difficult and interesting problems in such a truly scientific spirit, and that it would be most presumptuous to assert that their researches will not be successful in solving this venerable puzzle. What, then, best meets the case? What will best explain all the seeming contradictions? Will a gas, an aeriform imponderable thing, or a germ imperceptible to our microscopes or in our test-tubes, or will the result of a variety, or combination of abnormal conditions which are capable of acting on the centres and vaso-motor mechanism, so as to induce internal congestion, structural visceral change, or those nervous phenomena, alterations of temperature and nutrition, that are comprehended in an attack of fever, do so? This is the question that we want to solve.

Meanwhile, I content myself, provisionally, with the working hypothesis of an entity "malaria", and speak of *it*, and its influences, as though it really were a particulate thing. Klebs and Crudelli's bacillus theory is beautiful, and explains as much, if not more than, any theory that has preceded it; still it wants confirmation. Theories of an organic cause are not new; from Vario and Lucretius down to Linnæus, thence to Salusbury and others, such views have been put forward and again been laid aside, but never stated with such force or probability as by Klebs and Crudelli; and these are already disputed. I do not know yet what Indian research has done in this matter, but it is in competent hands. As it stands, we must accept the bacillus theory with caution; for however much we may be inclined to do so, it would be as rash to accept it as established, as it would be presumptuous to assert that it will not be so.

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International Health Exhibition,

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HOME LESSONS AFTER SCHOOL HOURS.

By Sir JOSEPH FAYRER.

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HOME LESSONS AFTER SCHOOL HOURS.

By SIR JOSEPH FAYRER.

THE proposition which I have to submit for your consideration, as the third of four which comprise the subject-matter of this Conference, is stated in the following terms :—"That it is contrary to sound physiological principles that children of tender age should be called upon to perform home work after school hours." This proposition immediately precedes another, to the effect that there is abundant evidence that the strain of so-called education is excessive, and that it acts as a pre-disposing and exciting cause of disease, of serious and occasionally fatal character. If this can be sustained, the subject of my proposition, which is essentially a part of it, must needs be regarded as contrary to sound physiological as it is to sound ethical principles.

It has already been argued that whilst the prevailing systems of schooling are too severe, and are attended by an undue expenditure of vital force, the long hours of confinement, too often spent in a vitiated atmosphere—and sometimes, it is to be feared, with insufficient food—coupled with ordinary conditions of school work and discipline, are productive of injury to physical health and due development of the frame, especially as regards the heart, lungs, and organs of vision, to an extent that must be regarded as a matter of national importance.

These statements form so grave an indictment against the present system of education, that it seems expedient the subject should be sifted, with the view of ascertaining how far the charges can be maintained and the evil rectified ; for if it be proved that such strain exists, there

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is no escape from the conclusion that interference is demanded, not only by parents and guardians but by the legislature itself! I am aware that this question, like others, has more than one aspect, and that high authority and earnest persons deeply interested in education have pronounced the outcry devoid of foundation, and the charge of over-pressure to be exaggerated, if not altogether untrue. It is a difficult question to decide, for there are complications and disturbing elements in dealing with it which may render it hard to furnish statistical proof of that which is still so thoroughly impressed on the minds of many, by personal observation and experience, that it would be futile to deny there is substantial ground for alarm, inquiry and reform. It would be unfair, I think, to hold the teachers as altogether or solely responsible. The natural desire to extend intellectual culture, and the stimulus of competition, so severely the rage in the present day, together with imperfect knowledge, or at all events imperfect recognition of the physiological bearings of the question, tend to intensify a struggle in which immature brains and bodies are striving for pre-eminence, and in which it is asserted that many suffer, and some altogether break down!

The object of this communication is to show that this over-pressure, especially in young children, is wrong in principle and hurtful in practice, and that it tends, by the injury it may inflict on the general health, rather to retard than to advance education!

Charles Kingsley, a true philanthropist and friend of children, whose keen sympathy and knowledge of their nature and their needs makes all he says about them worth reading, evidently had this subject in his thoughts when he wrote in one of his charming stories:—"There were as pretty little children as you could wish to see, and might have been still if they had only been left to grow up like human beings, but their foolish fathers and mothers, instead of letting them pick flowers and make dirt pies, and get birds' nests, and dance round the gooseberry-bush, as little

children should, kept them always working, working, working, learning week day lessons all week days, Sunday lessons all Sundays, weekly examinations every Saturday, and monthly examinations every month, yearly examinations every year; everything seven times over, as if once was not enough, and enough as good as a feast, till their brains grew big, and their bodies grew small, and they were all changed into turnips, with little but water inside, and still their foolish parents actually pick the leaves off them as fast as they grow, lest they should have anything green about them."

It is impossible not to admire or, to a certain extent, sympathise with the spirit which insists so passionately on the diffusion of education, and with the systematic efforts by which all classes of our infant and young population are brought within its influence. The machinery of our schools, from the highest, to the smallest dependency of the School Board, is so complete as almost to excite a feeling of envy for the great advantages denied to us, but which are now freely accessible to everybody's children, and we are thankful for the philanthropy which declares that no child in the state shall grow up in ignorance, because education is the means by which a nation should be elevated, and the people rendered prosperous and happy. But it is possible, nay, I fear it is probable, that by over zeal we may be doing harm; for whilst, for education, conducted on sound principles, we can only express appreciation and gratitude; of a system of competitive brain forcing any cramming, we can only say that it is worse than and neglect of schooling which may have preceded it. It is not meant that education of all young persons is of this character, but that there is great tendency to it there can be little doubt; and whilst on the one hand we gratefully recognise the high purpose which is directing national education, we must hope, on the other, that the defects may be remediable by a better appreciation of important physiological considerations hitherto perhaps too much overlooked.

It would be impossible in the short space of time at my disposal to state all the anatomical and physiological arguments in support of the proposition, nor is it necessary. It is sufficient to say that this is based on the intimate co-relations subsisting between nutrition and growth of the body and brain and intellectual development. The necessary conditions for the well being of the body are, we know, pure air and water, appropriate food, with due intervals of rest, and such exercise of the various parts and organs as to fit them for the due performance of their functions; so it is with the brain and nervous system generally, and a brain, however gifted or powerful it may be potentially, will fail, unless the conditions of healthy physical life be observed. It is to be remembered also, that during the rapid growth of infancy over-exercise of the cerebral functions, by creating a greater demand for increased blood supply, tends to interfere with the due nutrition of the body and to entail disease. It has been observed that during sudden and rapid growth in young persons the brain power has been diminished to a state of apathy or even of abeyance, whilst on the other hand it has been remarked that the lethargy, the clouding or weakening of mental energy, in such young persons has cleared away as the growing fit has ceased, and the general vigour of body been re-established. Needless to insist upon the great care and discretion with which young brains should be worked at these critical periods. Let me, for the benefit of non-medical hearers, mention one or two anatomical facts which have an important bearing on these questions. The brain of a child at birth weighs about twelve ounces; it grows so rapidly, that by the age of three years it has attained to three quarters of the full weight. It continues to increase rapidly till about the seventh year, when it has attained to nine-tenths of its complete weight. Thence on to twenty it still increases, though slowly, and again slower still it grows, till it attains the full measure of its size and power at from thirty to forty years of age. Brains vary in different individuals in

size, texture, specific gravity, and quality. They *may* attain, as in the case of Cuvier, to sixty-five ounces, or they may never surpass the average of the European standard of from forty to fifty ounces. The mass and weight of the brain have a certain but not absolute relation to the bulk of the body as they have to the amount of intelligence; this seems to depend on the relative proportions of grey and white elements as well as on the texture and molecular arrangement; and on these depend also its aptitude for development by education. It is during the rapid and early period of growth and development that its susceptibilities are most acute, and are most severely tested, whilst its due evolution is most seriously affected for good or evil.

The question therefore is, how much work is compatible with the welfare of a young growing brain? There is a just medium between too much and too little, which, whilst on the one hand it shall not overtax functional, on the other shall favour physical development. In short, how train these young brains so as to obtain the best results—not such results as are represented by early precocity and premature exhaustion—it may be by some form of encephalitis —not the production of an instrument which will act as a temporary receptacle for the registration of facts and figures which are lost almost as soon as attained; but an organ which, being susceptible of progressive development, shall be an instrument throughout life of larger and ever increasing powers.

The antagonism between growth and education may be seen in the stunted physical frames and feeble health of some in whom intellectual powers have been over pushed and prematurely developed, and it is the business of the physiologist to point out that an essential condition of healthy mental development in the young child, is healthy nutrition and growth of the physical organ by which mental activity is manifested.

Dr. Fothergill gave a lecture a few years ago on the relations of growth to education which I recommend all

concerned in teaching young children to read. I quote one brief but forcible passage from it. He says:

"The physiologist finds the subject come within his province, the physician has it before him in cases of illness brought about by over-taxation of the system from educational efforts. At the time that the tiny child is conquering the difficulties of the alphabet, its tissues are growing rapidly; and its nutritive powers have to meet the demands of its tissues, bones, and muscles, as well as those of the brain. It has to grow as well as to furnish nutritive material to the expanding brain, and there is also the increase in bulk of the brain to be met, as well as the wear and tear of functional activity. When the brain is insufficiently supplied with blood its power is cut down and limited. The brain requires nutritive material as well as any other organ for its active functional manifestations. It is as dependent on the body commissariat as the muscles of the legs; consequently, an essential point in all education of the young is to see that the nutrition is kept up by food suitable alike in quantity and quality. If this be not attended to, growth and education will be alike retarded. The child must have nutritive material for the needs of each."

It should be understood that to overtax the growing brain of a child is as erroneous, nay, more so, than to overwork or exhaust its body; either course is liable to entail penalties. Far more severe are those which avenge the over-wrought brain than the exhausted body!

In a recent admirable article, Dr. Crichton Brown has so clearly pointed out the evils of the form of overwork to which my proposition relates, that I venture to quote his remarks, as they forcibly express my own views on the subject. He says:—"School hours fall mostly in the early part of the day, but a little enquiry will reveal that the heaviest part of school work is not generally performed at that time. If any boy or girl be asked 'What is the most trying part of your school work?' the invariable answer is

'Preparation;' and if the further question be put, 'When do you do your preparation?' the almost invariable answer is, 'In the evening.' This is a state of matters that is to be condemned from a medical and from an economical point of view. The most severe brain effort that the child is called on to perform, that which involves most strain and concentration of attention, that opening up of new ground on which progress must greatly depend, is reserved for the period when brain function is almost at its lowest ebb, and when all the vital powers are exhausted by the exertions of the day. The most severe and important intellectual labour is undertaken just when it is sure to be most injurious and least remunerative. Evening preparation of lessons, if faithfully performed, must be prejudicial to the fatigued brain, and is not even rendered innocuous by a long interval of recreation between it and school work. It often induces sleeplessness and a long train of attendant evils, and contributes largely to the nervousness and debility which are becoming so common amongst school children, particularly in towns, while it fails in securing advancement at all equal to what might be got from a much less strenuous and protracted study earlier in the day.

"The most arduous mental work required of a child ought to be imposed on it when its mind and body are in their prime vigour, between 9 A.M. and noon, and nothing but the lightest work should devolve upon it after 5 P.M. To the medical eye preparation seems to be peculiarly the work which should be carried on in school, with the constant assistance of the master, whose special mission it is to explain difficulties, to remove obstacles, evoke interest, and stimulate endeavour. It is, perhaps, because some masters do not take this view of their office, but fancy that their duty is performed when they prescribe tasks, listen to the repetition of them, scatter over them a few critical remarks, and diffuse around them that magnificent moral influence, which is not, after all, a good substitute for hard work, that tutors and evening governesses have so often to help boys and girls with

their preparation, and that parents have to take upon themselves the real drudgery of teaching."

And, with regard to the important subject of rest, the great restorer of exhausted nerve force, and the invigorator of continued and sustained effort in education, that which is necessary not only to mental but to physical growth —sleep,—I quote again from the same eminent authority, my own experience most thoroughly endorsing the views he expresses :—"It is needless to insist on a sufficiency of sleep for our juvenile toilers, that is of primary importance; and long hours of rest are requisite for the brain which for many hours has to maintain a condition of high functional activity, for it is during the hours of rest that the organ itself is nourished and grows."

Again, Dr. C. Brown says :—

"Some statistics which I have collected in girls' high-schools give these results. In answers to the question, 'Which is the hardest part of your work?' sixty-five per cent. of the girls reply, 'Home work.' In answer to the question, 'When do you do it?' fifty-seven per cent. of these reply, 'In the evening.'

"Is any argument required to prove that that part of the day's work which involves most brain effort and brain exhaustion should not fall on these evening hours, when the nervous system is already fatigued, and when by the laws of its constitution it is least capable of exertion?

"Quite recently a medical man told me this story. 'I was called to see a girl of fourteen, and found her in bed, pale, with dilated pupils, displaying great muscular tremor and much mental disturbance. Her pulse was 120, and her general condition convinced me that she was on the verge of a serious cerebral attack. On making inquiries I discovered that she had been up till one o'clock in the morning of the day on which I was called to her, preparing her lessons for a high-school; and that, being an anxious ambitious girl, she generally worked till 11 P.M., and once or twice a week till one or two in the morning. I procured

a list of the lessons which she had had to prepare on the previous night, and it was as follows :—

"'1. Write the story of Touchstone, giving quotations.

"'2. Commit to memory twelve general questions in geography, each involving at least twelve particulars, such as courses of rivers, products of towns, positions of capes, &c., &c.

"'3. Write out six quarto pages of French grammar and construction.

"'4. Learn, so as to be able to write out in class, all the verbs in a printed page of Picciola.'

"Having to attend a music lesson in the afternoon the girl was unable to settle down to this work until 6 P.M., and from that hour until 1 A.M. the following morning she worked at it steadily. Little wonder that she couldn't sleep when she went to bed, and 'little wonder,' said my medical friend, 'that I found her on the verge of phrenitis.' Numerous cases more flagrant than this one might be collected."

On referring to Dr. Langdon Down as to the influence on young persons of home work in the evening after school hours, I received the following reply from that high authority ~~; and~~ I can only say that his opinions and experience seen confirm my more limited observations. I, too, have ~~cases~~ of a similar character to those he reports, and it is not unlikely that others are in the experience of many medical men. The expression of such opinions founded on observation, are more valuable than any statistical information, and cannot be set aside as evidence that some change in the mode of education should be effected. He says :—

"My practical experience is quite in harmony with your thesis.

"I have seen several cases where serious brain disturbance has been the outcome of over pressure.

"I find that the two most dangerous periods are those of second dentition and the period just anterior to puberty.

"I have met with children, and specially remember two cases, who lost speech between seven and eight.

"I have seen several cases of serious mental breakdown from having work to prepare out of school-hours. It begets over-anxiety, sleeplessness, talking and muttering during the diminished time of sleep, and finally hallucination of sight and hearing.

"I have recently had under my care a typical case in the Kensington district; before the boy returned to school I gave a certificate, pointing out the peril to him if there was any return to such practice.

"The payment for results is, I conceive, one very strong inducement to the evil.

"I have now under my care a boy of fifteen, who has shown very grave symptoms during his struggle for preparation for the matriculation of the University of London; and another, in his trials for Sandhurst, came home with symptoms which were at first taken for typhoid, but which proved, as I feared, to be cerebritis, and terminated fatally. I am quite satisfied that over pressure is very common, and specially perilous at the developmental epochs I have mentioned.

"I have had cases from public schools; several from the board schools; and formerly I used to see a great many pupil-teachers, as well as the unfortunate mistresses who had to prepare the pupil-teachers, but for some cause or other they have been less frequent of late."

The especial point of my thesis is, that evening work, i.e. preparation at home after school hours, is prejudicial to children of tender age; and from what has been already said, I think it must be admitted that it is so. For it has been shown that whilst a moderate amount of work in the early part of the day, say of two to three hours, under the guidance of the teacher, in which the mental efforts are not overstrained, is not only harmless, but necessary for the due development of the brain and its functions; yet that evening work is injurious, for the reason above defined. I venture to suggest, therefore, that it would be well for those engaged in teaching, or interested in education, to reconsider the question, and having in view the physio-

logical bearing of the subject, recast the methods of educating young children, especially in reference to the expediency of confining the intellectual training of those under ten or twelve years of age to work done in the early part of the day, and with the aid and supervision of masters; and that with regard to young people after that age, that the evening or preparatory work should generally be diminished below its present standard.

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III.

By Sir JOSEPH FAYRER.

I will endeavour to reply as briefly as I can to your request that I should state the opinion I have formed in respect of the system of competitive examination which now exists in this country, whether as regards its relation to and effects on education generally, or in the selection of candidates for various offices and appointments in the public services.

As regards the education of children and young persons, in elementary schools of all grades, in more advanced schools, colleges and Universities, I can claim no right, beyond such as appertains to all who are interested in education in its true sense, to offer any opinion, though I may at once say that having carefully considered the subject, I have long been impressed with the belief that examinations are too frequent and too severe, that they have a tendency to divert attention from the true aim of education by developing an artificial memory, rather than by gradually strengthening the

rational faculties and moulding the intellectual powers into the form which will render them most fitted for the duties and emergencies of life; that moreover they tend to interfere with sound teaching, by imposing on the teacher the necessity of following some method other than that he might have deemed most appropriate, because he is aware that he could not thus ensure the best chance, not of advancing the intellectual growth of his pupil, but of successfully passing him through a certain examination.

Further, I believe that the continual mental strain to which children and young persons are exposed has an injurious effect on health; for it is impossible to overwork the nervous system whilst the frame is still growing, without prejudice to one or the other, if not both, and there is good reason for believing that mental overstrain and cerebral irritation are not unfrequent results of the system of pressure which now obtains in some schools: my own experience, indeed, furnishes me with evidence that it is so. That the education and training of childhood and youth in these days is in advance of, and an improvement on, that of the past, in many and perhaps most, respects, cannot be doubted; but that it is defective in the direction above referred to I believe is equally certain; and I am glad to think that the time may be at hand when some healthful modification of it will take place.

As regards the education and examination of young men, experience of more than a quarter of a century, during the greater part of which time I have been teacher or examiner, and for the last eight years have taken part in the competitive examinations for the Navy, Army, and Indian Medical Services, has given me an opportunity of forming an opinion on the question as it relates to these departments of the public service, and has also enabled me to arrive at the conclusion that, though examination carefully conducted is indispensable, the inordinate practice and imposition of it is deleterious, demanding, as it does, incessant mental labour, and so preoccupying the attention and burdening the memory as to leave little time for real thought, digestion, or assimilation of the subject-matter on which real culture and knowledge of the work to be accomplished depend, whilst practical work is, as a matter of course, narrowed to the most contracted limits, and the vast jumble of information, which has been arranged in a certain form, sufficient to satisfy the examiner, is thankfully laid aside or forgotten as soon as the ordeal is past.

I think too much is expected. It is impossible that in four, five, or even six years the enormous amount of knowledge required by the medical graduate of the present day can be assimilated, or that he can really work up to that which it is supposed to represent. I venture to think that longer study of certain subjects, less cramming, and fewer examinations might advantageously be substituted for the system which now prevails. As for the examinations which are

meant to test fitness for the degree or qualification, whatever it may be, I think they also might be less severe, and directed to ascertain, *not* the candidate's ignorance of recondite or obscure points in science, but whether he be possessed of sufficient knowledge of the fundamental facts and theories upon which the science is based, to justify the examiners in pronouncing him to have the amount of information which is really sufficient to entitle him to receive the certificate.

Let any one read some of the papers now set in almost any qualifying examination, whether it be in medicine or other faculty or branch of science, and ask himself how many passed masters in the subject, nay, even how many examiners themselves, could answer the questions?

Whilst examinations to test progress, conducted by the teachers themselves, for the purpose of marking certain stages of the curriculum accomplished, or of finally attesting the fitness for a degree or certificate—such being well ordered and directed to ascertain what the candidate does, rather than what he does not, know—are useful and should be preserved, others of a more exacting character might cease, or be greatly modified.

It would seem that these rigid examinations, whilst they test the temporary possession by the candidate of a vast accumulation of facts or figures, give no assurance of gradual and progressive training and development of the senses and the higher faculties, and but very little of practical knowledge or aptitude for the application of some small part of that which he has acquired by rote.

I do not gather from what I have read in this Review that it is desired to abolish competition, but rather to remodel it, to make it what it sets itself forth to be—a mode of procuring the best. Could competition do this, then, with all its disadvantages, whatever they may be, I see neither how it could, nor why it should be, set aside.

Did the present method of education, with its attendant cramming, its overburdening of the memory, its overstraining of the brain-power, and its frequent and severe examinations, certainly supply the public services which depend on it with the best, then it must continue, despite the evils attributed to it; but it is just here that the question arises. Is it fair to assume that the relative general excellence of young men may be ascertained by testing them only in certain subjects? Does it follow that, because a man knows or remembers more Greek, Sanscrit, mathematics, anatomy, physiology, or chemistry than others—all alike be it observed, possessing more than qualifying knowledge in each subject—he is better than those who may perhaps excel him in numerous qualities which are untested but are quite as essential in forming an efficient public servant? Such, however, is the view implied in the present competitive system of examination,

and so it happens that men are stamped as the best who certainly would not justify such a conclusion were they submitted to a more general ordeal.

Competitive examination, no doubt, secures the man who knows most of some subjects; but until it test mental, moral, social, and physical, as well as intellectual qualities—even if it can do that—it cannot be admitted that it is what it professes to be, a provider of the best.

It is said that no better mode of providing public servants exists, and that it is better than the old system of patronage with all its abuses. It may be so, but there are many who think otherwise, and who believe that selection, after a *thoroughly qualifying test* has been passed, would be better, and who also think that some method of selection might be found which should obviate the possibility of jobbery or abuse of patronage. In any case there is room for improvement in the present system, and if the movement which has been initiated by this Review effect this, it will be of national service.

2/2 14.

VENOMOUS ANIMALS.

BY

SIR J. FAYRER, K.C.S.I., M.D., F.R.SS. L. & E.

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VENOMOUS ANIMALS.

Animals that possess the power of secreting and ejecting a poison, the effects produced by inoculating this secretion in man or other animals, and the appropriate treatment, will be briefly described in this paper. Poisons generated in diseased, enraged, or otherwise disordered animals, or such as may be formed after death by decomposition, or those by which teeth, claws, spurs, or other weapons of carnivora, predaceous birds, and fish or invertebrata, may be accidentally contaminated, are not included: for these refer to descriptions of rabies—hydrophobia, animal poisons, septicæmia. Nor are the effects produced by eating the flesh or drinking milk diseased or disordered by any cause included. It is known that the use of certain articles of food—certain states of health—changes during breeding, and in decomposition, may render the flesh or secretions of living creatures unwholesome, or even poisonous, but for descriptions of these refer elsewhere.

Vertebrata.

Mammalia.—The higher orders of vertebrata apparently have no venomous representatives, though the male monotremes, Echidna, and Ornithorhynchus paradoxus, are armed with a perforated tarsal spur, communicating with a crural or popliteal gland, which seems analogous to the poison apparatus in other creatures; no authenticated case of poisoning by this weapon, however, is on record, and its true use seems not to have been yet determined. Evil result following a puncture from this weapon, or from teeth, claws, or spurs of this or other mammal, may rather be attributed to the puncture than to an inoculated venom.

Aves have no known poisonous representative. Ill effects from wounds inflicted by their claws, beaks, or spurs may be referred to the lacerated or punctured nature of the wound, or to accidental contamination by extraneous septic matter.

Reptilia furnish the most numerous and important examples of venomous animals, and these are limited almost entirely to the

order Ophidia, which has three subdivisions: O. colubriformes, innocuous, O. colubriformes venenosi, and O. viperiformes, venomous. These are distributed widely over the globe, land and sea. The most venomous are generally denizens of warm climates.

The poison apparatus of a snake consists of a composite racemose gland, situated in the temporal region, which secretes a clear, slightly viscid fluid, that is poured through a duct into a grooved fang situated on a movable maxillary bone, capable of erection and reclination, to a greater extent in viperine than in colubriform snakes, by the action of muscles which push forward the ectopterygoid and maxillary bones, raise the fang, at the same time compress the gland and eject the poison through the duct into the groove in the fang; it is thus hypodermically injected into the bitten part.

The fangs are longer, more curved, more movable, and more formidable in viperine than in colubrine snakes—they are deciduous, and when lost by accident or by the process of shedding, are quickly replaced by reserve fangs that lie loose in a fold of mucous membrane. On the loss of a fang the most advanced of the reserves quickly takes its place, becoming anchylosed to, and moving with the maxillary bone.

The groove is on the convex aspect of the fang, and opens near the point for emission of the venom. There is an opening at the base of the fang, into which the poison is shed from the papillary orifice of the poison duct. This at the time of emission becomes closed in by a fold of mucous membrane, so that the poison is directed into the groove in the tooth.

Viperine snakes can recline or erect each fang independently of the other. This power is limited in colubrine snakes. The difference may be well seen in Naja tripudians—cobra; and Crotalus-horridus—rattlesnake. The poison is secreted in considerable quantities; half a drachm may be collected from a fresh and vigorous cobra. It is a clear, slightly viscid fluid, and very deadly in its action, probably more active in some snakes, quantity for quantity, than in others, and varying in activity in the same species or individual, according to season, temperature, state of health, etc. It acts most rapidly when injected into the blood; but it can be absorbed through mucous and serous membranes, as seen by its poisonous effects when applied to the conjunctiva, the stomach, the peritoneum. It may neither be applied to the lips nor taken into the stomach with impunity, and sucking a snake bite is by no means free from danger, though if the saliva be quickly ejected and the mouth washed, the danger is probably small. It contains an active principle, which has been described as echidnine, viperine, crotaline. Analysis has shown the poison to be very nearly like albumen in composition. It is most active in its action on warm-blooded creatures, but it takes effect in all. It appears, however, that poisonous snakes are very insensible to

the venom of other species of poisonous snakes. A cobra is not poisoned by another cobra's venom, but is probably affected by that of other species; and so with the others. But innocuous snakes, other reptiles, amphibia, birds, mollusca—indeed all life—succumb to it. Further analysis of the poison is needed. Though differing in activity and slightly in mode of action, the *modus lædendi* is essentially the same in all snakes.

The action of the poison is local and general.

Local.—Pain, partial paralysis of the bitten part, ecchymosis, swelling, and if death does not rapidly follow, infiltration of other and distant parts, cellulitis, sloughing.

General. — Depression, fainting, nausea, hurried respiration, vomiting, exhaustion, lethargy, loss of co-ordinating power, paralysis, loss of consciousness, hæmorrhagic discharges, relaxation of sphincters, coma, convulsions, death. If the quantity of poison injected be small or its nature feeble, the earlier symptoms may give way and recovery take place. Snake poison acts by paralyzing the nerve centres—sometimes the peripheral distribution of the nerves, and by altering the constitution of the blood. It takes effect through the circulation, and if inserted into a large vessel, such as the jugular, humeral, or axillary veins, it will cause almost instant death—the heart's action stopping, systolic spasm.

The respiratory centres, the spinal cord, the peripheral nerve distribution may all be affected; in ordinary cases death seems to take place by arrest of the respiration, the heart's action continuing for some time after apparent death. The convulsion or coma that precedes death is due to the circulation of venous blood. The muscular fibre itself would appear in some cases to have its contractility impaired or destroyed. The poison also acts septically, producing at a later period sloughing and hæmorrhage. There are certain points of difference in the action of viperine and colubrine venom. In the former there is greater tendency to hæmorrhage than in the latter. Experiments on animals showed, that generally after death from cobra poisoning the blood coagulated firmly, whilst after death from viperine poisoning the blood remained permanently fluid. In most cases of death in man the blood has been found fluid even after cobra poisoning. Snake poison is also to a certain extent a poison to protoplasm, at all events it arrested the action of infusoria, and was not without effect on ciliary action. The results of its influence on amœboid movements of blood-corpuscles was not definite.

There is reason to believe that the numerous agents that have been recommended from the earliest times as antidotes are useless, and have no such properties as those ascribed to them.

The rational treatment of snake poisoning is that of endeavouring to prevent the entry of the virus into the circulation, to support the failing nervous force if it have entered, and to aid in its elimination by all possible means.

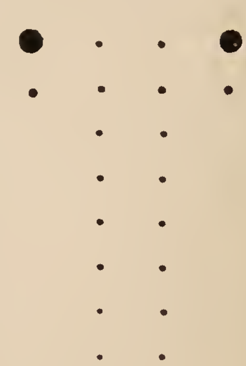
The application of a ligature applied tightly between the bite and the heart, the immediate excision or destruction by cautery or caustic of the bitten spot is essential, and such other local measures subsequently as appear necessary.

The constitutional treatment requires that the strength should be supported. Stimulants, such as alcohol and ammonia, have always been in repute, and probably with justice, though not in the sense to which the term antidote is frequently applied. Next—and if the respiration be failing, the use of artificial respiration should be resorted to. Elimination by the skin and kidneys should be encouraged and promoted by stimulating diuretics. The patient should be kept warm. It is not reasonable to make him exert himself by walking about; he is already sinking from nervous prostration, and forcing him to exhaust himself more is not likely to do good. Ammonia has always held a high place among remedies in snake poisoning, and its injection into the veins has been warmly advocated in Australia, and seems to have met with success there that it had not in India. In cases of moderate severity, and happily many are so, remedies with careful nursing and tending may prove successful, but where the bite has been thoroughly effected by the cobra, daboia, rattlesnake, craspedocephalus, cerastes, and others, the prognosis is very unfavourable; in no case, however, should efforts be relaxed until the last.

There is often uncertainty as to the kind of snake, its condition, and the extent to which its fangs were used. The great shock or depression which follows a snake bite may be in a measure due to fright, and will, on reassurance, pass away. The marks of two well-defined punctures attest the insertion of two fangs, and if the snake has not been seen, may enable one to form an opinion as to its character. Many of the innocuous snakes are fierce, and bite vigorously, but their numerous teeth leave different marks to those of the poison fangs.

There are exceptions to this rule; a few innocent snakes have the anterior maxillary teeth developed like poison fangs, but bites from them are not very likely to occur.

In a brief notice of this kind it is not possible to enter into much detail, but it may be well to note some of the characters that distinguish the venomous snakes. The form and arrangement of their teeth, and an examination of the mouth, will always reveal the true character. On opening the mouth of a venomous colubrine snake, such as naja or bungarus, two well-developed fangs will be observed, one on either side, and close behind it there may be seen one or two smaller teeth; there is no row of teeth along the outer side of the mouth, but a double row will be found on the palatine surface.



In the viperine and crotaline snakes, a large fang will be found

on either side, and a double palatine row. There are no small fixed teeth behind the fangs as in colubrines, but in a fold of mucous membrane at the base of the fangs, both in vipers and colubrines, a set of loose reserve fangs will be found.

In Hydrophidæ the fangs are arranged like those of the cobra, but are very minute, and no reliance can be placed on any mark made by them. The circumstances under which a bite is inflicted will generally help to indicate the kind of snake.

Harmless snakes have a double row of equal or nearly equal-sized teeth in the maxillary and palatine bones. There are certain innocent colubrine snakes that have long anterior maxillary teeth that might cause doubt as to the nature of the bite, but such are very exceptional.

There is nothing (except the hood in Najadæ) in colubrine snakes peculiarly characteristic, in their general aspect, of their venomous character; at first sight for ordinary observers it is difficult to say whether they are poisonous or not. Indeed, several of the innocent have a more repulsive aspect than poisonous species.

The viperine and crotaline snakes are remarkable for their broad arrow-shaped heads, often without shields, their thick bodies and short tails. They have thick, swollen looking lips, from the large fangs underneath them; and the nasal pits in Crotalidæ are very conspicuous. The Hydrophidæ are recognised by their compressed bodies and tails. Their peculiar heads, which in some species is very small, the valvular nostrils, and the absence, except in one genus, Platurus, of ventral scales. They are obviously aquatic, and are always found in the sea or on the shore. Space will not admit of more than a general indication of the genera, and of the geographical distribution of the venomous snakes.

These belong to the families Elapidæ, Hydrophidæ, Viperidæ, Crotalidæ. Elapidæ is a large group, widely spread over the Indian and Australian regions, and in America. It contains the truly venomous snakes, such as ophiophagus, naja, bungarus, hoplocephalus, pseudechis. The genera naja, ophiophagus, bungarus, pseudonaja, xenurelaps, doliophis, magrophis, and calophis are Oriental, and in Japan. An ophiophagus has been found in New Guinea. Cyrtophis, elapsoidea, and poccilophis in Africa. Elaps in America, but not in the West Indian Islands. Diemenia, acanthophis, hoplocephalus, brachiurophis, tropidechis, pseudechis, cacophis, pseudonaja. Denisonia and vermicella are Australian. The two first in the Moluccas and New Guinea. Ogmodon in the Fiji Islands (Wallace). There are 100 species.

Family Hydrophidæ.—These are sea snakes, and probably all very poisonous. They have a wide range of distribution in the Indian and Australian seas, from Madagascar west to Panama east.

Genera.—*Hydrophis* has numerous species, and probably many yet undescribed. They are found in the Indian seas about Formosa, and in Australia. *Platurus:* 2 species; Bay of Bengal, New Guinea, New Zealand. *Aipysurus:* 3 species; Java, New Guinea, Australia. *Disteira:* 1 species. *Acalyphis:* 1 species; S.W. Pacific. *Enhydrina:* 1 species; Bay of Bengal, New Guinea. *Pelamis:* 1 species; Indian and all Eastern Seas. *Emydocephalus:* 1 species; Australia.

Family Viperidæ.—In India, Ceylon, Africa, Europe. The common viper Pelius berus has a very wide range, from Portugal to the Island of Saghalien (Wallace); it is poisonous, but not deadly. The daboia of India and Ceylon, echis of India, puff-adder, cerastes of Africa, are deadly vipers.

Genera.—*Vipera* has 2 species, extending (Wallace) over Palæarctic and Ethiopian regions, but not in Madagascar. *Echis:* 2 species in India, Persia, North Africa. *Atheris:* 3 species; confined to West Africa.

Family Crotalidæ.—The pit vipers, a numerous group, containing some very deadly snakes. The craspedocephalus of the West Indies and the rattlesnakes of America. They are unknown in the Australian and Ethiopian regions.

The genera are:—Craspedocephalus, of which there are seven species, in tropical America and the West Indies; some are very poisonous. Cenchrus, crotalophorus, uropsophorus, crotalus, in North America, from Canada and British Columbia to Texas; one species, Crotalus horridus, extending to South America. Trimeresurus, 16 species, all in India, Ceylon, Africa, Formosa, Philippines, Celebes. They are poisonous, but not nearly so much so as are the rattlesnakes. Peltopelor and hypnale in India. Calloselasma, in Siam, atropos in Java. Halys, 3 species; in Tartary, & Himalayas. These are not very poisonous; though they may cause severe symptoms, are hardly able to destroy life.

Amphibia.—None are known to possess a poison apparatus like that of ophidia, but toads and salamanders secrete a fluid in glands along the back, connected with the integument, which yields an actively venomous principle capable of causing local irritation, and when injected into the blood, death, preceded by symptoms indicating action on the cerebro-spinal nerve-centres. Dogs seizing the toad, Bufo vulgaris, have been observed to suffer from swelling of the lips and salivation; and a case of death is related in a French journal, 29th March 1865, of a child in whom an abrasion of the hand came in contact with the secretion of a toad; death was preceded by vertigo, vomiting, fainting.

Injected into guinea-pigs, small birds, and other animals, violent symptoms and death soon follow. It is a viscid, milky fluid, with a slight yellow tint and peculiar odour; it is exuded, or may be pressed out from glands behind the orbits. Zalesky has shown that the land and water salamanders, S. maculatus and Triton cristatus,

and probably others, have also the power of secreting venom, and his experiments prove that it contains a very active principle—salamandrine, and that its action on the cerebro-spinal nerve centres is energetic.

It appears that these poisons, like those of ophidia, though effective on others, have no action on their own species. It is probable that all species of these families have the same active principle in their glandular secretions, though in different degrees of intensity.

I am indebted to Dr Leibrich of Berlin and Dr T. Lauder Brunton, F.R.S., for the accompanying abstract of what is known on the subject of poisonous amphibia.

Abstract of Paper by Zalesky on Poison of Toad, Triton, and Salamander.

"Poison of fishes depends upon their food, and is not always present, *vide* Siguatera on 'Fish Poison Disease,' *Social Science Review*, July 19, 1862.

"Bombinatur igneus is poisonous, its poison is probably the same as in salamander. Three poisonous salamanders: Salamandra maculata = land salamander, Triton cristatus = water salamander, Salamandra venenosa (Barton) Daudin, *Histoire Naturelle des Reptiles*, vol. viii. p. 229.

"Land salamander has different names: Lacerta salamandra, Salamandra maculosa, S. terrestris.

"'Researches on Toads,'" John Davy, *Phil. Trans.* 1826, p. 127; Gratiolet and Cloëz, *Compt. Rend.*, April 21, 1851, t. xxxii. p. 592. Secretion of salamander in birds caused convulsions, opisthotonos, and death. In animals, laboured respiration, weak convulsions, recovery. They say secretion has a strong odour and marked acid reaction. Secretion of Rana buffo killed birds in five to six minutes without convulsion.

"There was also stupor from poison of toads and of earth salamanders. Injected under skin of foot of tortoise it caused paralysis of the limb after some days, which did not disappear in eight months. The poison when dried preserves its qualities indefinitely. It contains an alkaloidal substance which causes excitement, then irritability, then paralysis, death. In all birds killed by it the semicircular canals were found filled with blood.

"Vulpian, *Mem. de la Soc. de Biolog.*, 1856, p. 122, found in dogs and guinea-pigs triton poison caused progressive weakness without convulsions, although twitchings of individual muscles, and weak respiration and heart's action. Membranes of brain congested. No vomiting. Not poisonous for tritons. Intense local irritant to the eye.

"Land salamander causes convulsions. Appears to act on spinal cord. Much weaker action on the heart than the poison of triton.

"Poison of toads, Bufo fuscus and B. viridis.—In dogs—violent

vomiting, staggering gait, convulsions, death. In guinea-pigs—efforts to vomit, convulsions more violent than in dog, but were intermittent, and only became constant shortly before death; then opisthotonos, grinding of teeth; death in ½ to 1½ hour. Symptoms in warm-blooded animals may be divided into four stages: 1, excitement; 2, relaxation; 3, nausea or vomiting; 4, convulsions. Given internally to a dog it only causes vomiting, and animal recovers.

"Poison does not affect irritability of nerves or muscles. *Post-mortem* examination in dogs showed heart motionless, filled with blood, lungs pale, heart contracted when galvanized. In frogs, toad poison causes convulsions, emprosthotonos, paralysis, contraction of pupil. Death in one hour. The poison paralyzes the movements of heart in frogs. It does not affect toads. The poison of toads kills tritons. The poison of tritons kills toads. The poison of land salamander kills toads and tritons. It is not known whether the poison of toads and tritons kills land salamanders.

"*Zalesky's experiments.*—Milk-like secretion of salamander obtained by scraping back with spoon. It only comes out under pressure, and easily spirts into eye, but animal cannot eject it. It is white, thick, strongly alkaline, acrid and bitter, slight smell not unpleasant, microscopically it is like milk. The granules disappear on addition of alcohol, ether, and acetic acid; when fresh secretion is put in water the greatest part remains undissolved in cheesy flakes. The water, however, becomes milky and turbid, and acquires an alkaline reaction and peculiar smell. The substance which causes the turbidity is not precipitated by acids or alkalies, but is by ether. The precipitate is soluble in hydrochloric acid, and is again precipitated by water.

"The watery solution coagulates at 59°, and gives white cheesy precipitate. On filtration the filtrate is clear, colourless, with pleasant smell, and *intensely poisonous.* It contains much phosphoric acid and nitrogenous substances. Dried over sulphuric acid in vacuo, it leaves amorphous brittle residue, which redissolves sparingly in water or alcohol. When completely dried it *loses* its *poisonous* power. When the concentrated solution is acidulated with hydrochloric acid, it gives on drying fine needle-shaped crystals, which are *not* poisonous.

"The watery extract may be boiled for a long time without losing its poisonous power. Phosphomolybdic acid (phosphormolybdausäure) precipitates copious yellowish white cheesy flakes from the hot watery extract. The precipitate is intensely poisonous. It was washed, dissolved in baryta water, excess of baryta removed by CO_2, boiled, filtered, filtrate distilled in tubulated retort over naked flame, then completely dried over water bath in a current of hydrogen. Before the residue is completely dry numerous long needle-shaped crystals form, which disappear when the drying is complete, leaving a brittle, colourless, amorphous mass. This is

almost entirely soluble in water. The solution is strongly alkaline, is precipitated by chloride of platinum, and also by phosphomolybdic acid. It is exceedingly poisonous. It produces all the symptoms caused by the entire secretion.

"Even by drying in the stream of hydrogen a part of the base was so altered that a resinous body was produced, insoluble in water, soluble in alcohol, solution fluorescent, fluorescence disappeared after some time. The aqueous or alcoholic solution of this body when saturated with HCl, and dried on a water bath in a stream of H, leaves before it is dry long crystalline needles, which disappear when the drying is complete. The substance when fully dried contains hydrochloric acid. The free base when once dried retains its poisonous power for months.

"*Results.*—Samandrin is an organic base, not volatile without decomposition, easily soluble in water and alcohol, crystallizes with water of crystallization. Solutions are strongly alkaline, forms neutral salts with acids, precipitated from solution by phosphomolybdic acid, also by chloride of platinum which decomposes it. It is not decomposed by boiling its solutions, but is by gradual drying in air; when dry it is permanent.

"*Test.*—Precipitate by phosphomolybdic acid, dissolve, evaporate to dryness with $PtCl_4$ on water bath, a transparent amorphous blue mass insoluble in water forms during the drying.

"*Symptoms produced by it.*—After a few minutes (three to twenty-nine) the poisoned animal trembles, is restless, epileptiform convulsions occur, at first weak and confined to single limbs. The animal moves, but goes backwards, instead of forwards; there are violent convulsions of the muscles of mastication (especially in rabbits), and marked salivation, most when the fresh secretion has been used. The convulsions increase; there is opisthotonos, the animal can no longer sit, but falls in convulsions to the ground with head bent back. The eyes are open, the pupils much dilated and insensible. The animal seems insensible to all irritation, the respiration is weak, the pulse irregular, but strong, the muscles relaxed. During the convulsions the activity of the heart is unaltered, but respiration completely suspended. They last only one to two minutes at most, then there is rest, and then another often stronger than before, so that the animal is thrown clean into the air. Death occurs from exhaustion, with symptoms of paralysis. Rigor mortis comes on quickly, blood very dark, often bleedings in lungs, heart and veins full, heart pulsates after respiration has ceased. Brain normal, only great congestion of it and liver.

"In fish it produced rigidity of body (quiet respiration) and death.

"In dogs, given by mouth, salivation, restlessness, vomiting, convulsions limited to posterior part of back and feet, intermittent, sudden like an electric shock. Vomiting and convulsions increased, *pari passu*, and convulsion affected whole body. During

intervals between the vomiting the convulsions were less violent; but with nausea or vomiting they increased, and there was opisthotonos or pleurosthotonos.

"In frogs—in two minutes respiration quickened; in eight to ten, irregular, laboured, and with long intervals. Muscles of belly, neck, and chin take part in the respiratory movements. After fifteen to twenty minutes more, convulsive movements of single muscles, especially in back and extremities. These come and go instantaneously like electric shocks.

"Emprosthotonos and rest alternately; sensibility gone. After four to six attacks, complete paralysis, with twitchings in single muscles. This condition may continue two to three days before the frog dies. The nerves and muscles retain their irritability. The symptoms are not altered by ligature of the aorta in belly of frog. Poison does not seem to affect the heart very much."

Pisces.—Several fishes are provided with an apparatus consisting of a cavity at the base of, or a sac and duct leading to a channelled spine, through which a more or less irritating secretion is ejected. No true poison gland, however, has as yet been certainly made out. This secretion is apparently connected with the secreting mucous system, and it is well known that in certain species it produces marked symptoms of poisoning, though never to the same extent as in the case of the poison of venomous snakes.[1] Fish armed with sharp or serrated opercular or fin spines can inflict severe and painful injuries liable to cause great pain, and to be followed by the grave symptoms attributable to the lacerated or punctured nature of the wounds, and these may be aggravated by the irritating nature of the mucus with which they are contaminated. In several, however, in addition to the spine there is a distinct receptacle in connexion with it, either in the form of a sac or duct, such as in thalassophryne, in a cavity in the spine itself, as in trachinus.—*Weever.* WEEVE

In the case of others, such as the sting rays, which may produce severe wounds by their pointed and serrated spines, there is no distinct receptacle for the poisons in connection with them. The ill effects of such wounds are so well known to fishermen and others, that the spines are generally broken off as soon as the fish is caught; and in France and Spain fishermen are obliged by police regulations to do this before the fish are exposed for sale! Whilst it is well known that many spiny fish are capable of inflicting wounds that are dangerous from their lacerated and punctured character, it is recognised, also, that others increase the danger by the inoculation of an irritating fluid; and the following are the most remarkable among them (*Day*):—

[1] Experiments on the action of this poison are needed; it is probable that in its action and composition of its active principle it would be found to resemble that of the salamanders.

I. Sub-Class.—TELEOSTEI.

a. Order—**Acanthopterygii.**

A. Family—Trachinidæ.

Genus—*Trachinus.*

1. Trachinus draco, } Great Britain.
2. T. vipera, } Great Britain.
3. T. araneus, Mediterranean.

B. Family—Scorpœnidæ.

Genus—*Synanceia.*

1. Synanceia verucosa, East Coast of Africa, Red Sea, Indian Seas.

All the individual members of this family are reported poisonous.

Synanceia, says Sir J. Richardson, is more dreaded by the people of the Isle of France than snakes or scorpions. The dorsal spines are the weapons, and they have a receptacle for poison at the base of each.

C. Family—Labyrinthica.

Genus—*Polycanthus.*

1. Polycanthus cuparus, found in ditches and paddy fields along the Malabar and Coromandel coasts in India generally, within or not far removed from tidal influences. It hides under stones and among weeds; about $3\frac{1}{2}$ inches long.

b. Order—**Phyostomis.**

Family Siluridæ.

Genus—*Thalassophryne.*

1. Thalassophryne reticulata, } Coast of Panama. Grows to ten inches in length. In these the poison seems most highly developed.
2. T. maculosa, } Coast of Panama. Grows to ten inches in length. In these the poison seems most highly developed.
3. Saccobanchus fossilis, Malabar. Is much dreaded by the natives, who call it the scorpion-fish, for the irritating wounds it inflicts with pectoral spines. ~~and~~ Wounds from the siluroid genus Clarus are much dreaded.

II. Sub-Class.—CHONDROPTERYGII.

Order—**Plageostomata.**

Sub-Order—*Batoidei.*

Family—Raiedæ.

Family—Nygonidæ.

Rays.

The latter sub-class are capable of inflicting severe wounds, but it is doubtful if there be any poison inserted into the wound. Probably there are others that are capable of inflicting severe envenomed, others merely lacerated or punctured, wounds. It is sufficient to indicate the certain danger of some, and the probable danger of other spiny fish. There is no ground for supposing that there is any poison apparatus connected with the teeth of fish. The effect of the poison is to produce severe burning pain at and beyond the injured part, with fever, and the intensity would,

no doubt, depend on the quantity of poison injected, and the state of health and constitution of the person at the time. The wound alone, without any poison, is likely to be painful and severe from its punctured character; and may require means to relieve tension, evacuate pus, or give exit to sloughs.

Ipecacuanha, alkalis, alum, ammonia, have all been recommended as useful internal applications to allay the irritating action of such poisons. Poultices of onions, or warm applications of opium or other sedative fomentations, are likely to be useful; and prompt surgical relief, if suppuration or cellulitis occur, is necessary.

The constitutional treatment needs no special description; it is such as would be indicated by the condition and progress of any other inflamed punctured wound. In case of depression of the heart's action, alcohol or ammonia would be indicated. Rest, quiet, and due attention to the state of the bowels and of elimination by the skin and kidneys, with careful regulation of the diet, should be observed.

Invertebrata.

Mollusca.—*Aphysia punctata*, the sea-hare, a gasteropod, is said by some to produce an irritating secretion capable of causing urtication and even severe inflammation, and of causing the hair to fall off. It was used by Locusta in Nero's time as an ingredient in poisonous draughts, but it is doubtful if it be even an irritant.

Arthropoda, Myriapoda, family *Scolopendridæ*, or centipedes.—Body long, even to 12 inches, divided into horny segments; legs short, strong; feet numerous; antennæ 17 to 20 joints. They have mandibles or nippers, formed by a pair of dilated feet, joined at their origin, with perforated, hook-like points with an aperture near the apex, through which a poisonous fluid, secreted in a poison gland, sac, and duct, is ejected when they bite, which they can severely. This, in the case of the larger tropical species, is sometimes very painful, and causes considerable local irritation and even constitutional disturbance, and fever and delirium. Dr Linceicum says that he saw a case of a child terminate fatally in six hours; nausea, vomiting, and convulsions preceded death; body swollen and covered with livid blotches. That of the smaller kind generally causes only local and transient irritation. Centipedes are found all over the world nearly, in Europe and Africa, America, the East and West Indies and Islands, and in the tropics generally. Those of warm climates are the largest and most dangerous.

The following are characteristic genera and species:—

Scolopendridæ—Pallipes.
S Crassa.
Ceylonicus, Ceylon.
Morsitans, West Indies.

Scolopendridæ—Platypoides, Brazil.
Placeæ, Brazil.
Variegata, Brazil.
Angusticollis, Old Calabar.
Tuberculidens, East Indies.
Leachii, Cape de Verd Islands.
Cœruleo viridis, New Holland.
Cryptops—Hortensis, British.
Lithobius—Fortificatus, British.
Cermatia, distinguished by its long spider-like legs.
C. Capensis, Cape of Good Hope.
C. Smithii, New Holland.

These are venomous, but it is not very likely that they should injure men. There are others, but it is unnecessary to detail them here.

ARACHNOIDEA.—*Scorpionidæ* or *Pedipalps*.

Scorpiones (true scorpions).—Have the abdomen segmented, the last six joints narrowed into a tail, terminated by a curved perforated spine or hook, with which they strike and wound. At its extremity are two small orifices, through which venom is injected from a gland receptacle and duct at its base.

The palpi are large, and formed like the claws of a lobster. Scorpions run about very quickly, carrying the tail curved over the body. They live in holes in the ground, under stones, logs of wood, in dark places. The tail is used as an offensive and defensive weapon. They seize small creatures, insects, with the palpi, and then pierce them with the sting. The venom is so active that it quickly destroys life.

Those of tropical climates are most active and poisonous. They attain to the length of from two to three, four, and six inches. The European genera are smaller and less active.

They exist in all tropical countries, but extend also into the warmer regions beyond the tropics. They are found in the East and West Indies, Ceylon, and other islands, Australia, Africa, Egypt, south of Europe, America. There are several genera, such as Androctonus, B~~a~~thus, Brotheas, Ischurius, Væjo~~p~~is, Opisth-ophthalmus, and the following species—B~~a~~thus afer, Androctonus. B~~a~~thus Cæsar are good examples of the active kinds. Europæus and Occitanus are also venomous, but those of Europe are less active than the tropical forms.

Solpugidæ, Galeodes—has some individuals reputed to be venomous, but proof is wanting. They are like large spiders. Galeodes araneoides is said, but has not been proved, to be poisonous to man.

The effects of the scorpion's sting and centipede's bite have no doubt been exaggerated, but they may produce very painful, and in the case of the larger species, severe and serious symptoms in their character, not unlike, or even more severe than those of the wasp

sting: pain, swelling, in some cases numbness, vertigo, nausea, vomiting, temporary loss of vision it is said, swelling of the tongue, fever and death in delicate and feeble or sickly subjects. The local and constitutional symptoms may be severe in persons of irritable constitution, or otherwise out of health, but generally in the case of bites of ordinary scorpions or centipedes inflicted on healthy subjects, the suffering is local and soon passes away. A variety of remedies have been recommended. Probably the application of a ligature above the bitten part, or a cupping-glass, or suction of the wound, as in snake bite, might be useful. Some authorities recommend that the wound should be scarified, volatile ointment rubbed in, and an emollient poultice applied. Suction of the wound, the application of salt water, vinegar, ammonia, alum, ipecacuanha, spirits of camphor, eau de Cologne, tobacco water, turpentine, tincture of iodine, alcohol, the leaves of cruciferous plants made into poultices, solutions of opium and lead, or other sedatives, all seem to lessen pain and irritation. For the constitutional symptoms, the use of diffusible stimulants, opiates, or other sedatives may be necessary, and such surgical interference as inflammatory action inducing suppuration or cellulitis may render necessary.

It is a popular notion that the scorpion loses its venomous power after being at sea for a short time. This is probably not the case.

Arachnidæ.—*Spiders.*—Some spiders are venomous, and certain of the larger tropical forms are capable of inflicting painful bites. The poison apparatus of spiders consist of falces or modified mandibles or jaws, the last joint of which is a hard curved fang, with a fissure near the point; there is an elongated poison sac and duct in which the venom is elaborated, and thence transmitted to the fang, by which it is inoculated into the flesh of its prey. The venom is a very active principle, and apparently capable of destroying the life of the small creatures on which the spider feeds rapidly. It also causes symptoms of poisoning in man and other animals. Probably all the species have some venomous secretion, but it is only the larger kinds that are obnoxious to man. It may be noted that whilst the fangs of one section of spiders move laterally, those of the Mygalidæ move vertically.

The Mygalidæ, or mouse spiders, grow to a large size. They are covered with a felt of hair, have vertical fangs, are very fierce, and are said to kill and eat small birds.

There are several species. Those reputed venomous are tropical.

e Mygal~~a~~ Klieglii, Western Pampas.
M. versicolor, Brazil.
M. californica, America,
and others.

Therididæ.—Lactrodectus malmignatus, a black spider, with ten blood-red spots, South Europe, Spain; is said to be very poisonous and even dangerous to man. It is probably identical with the Tendaraman of the cork woods of Morocco, which also has an evil reputation. There is an allied species in Corsica, Marmignatte (Therididaæ tredecim guttatum), also said to be very poisonous. This spider kills its insect prey, such as locusts, instantaneously. It has thirteen red spots. Others with similar powers are said to be found in Southern Russia and in New Zealand.

Lycosidæ, or Wolf Spiders.—Lycosa tarantula is reputed to cause extraordinary symptoms, and has given rise to the stories about dancing; hence the Tarantula of Naples. It is poisonous, no doubt, but there is no reason to believe that its effects exceed a certain amount of local irritation.

There are numerous families, genera, and species of spiders; in all, probably, evidences of the possession of an irritating fluid may exist, but it is only in the larger kinds that they do so to any extent, and there is no very positive proof that even in tropical climates they can inflict the grievous injuries ascribed to them, though there can be no doubt that the venom is very fatal to the creatures on which they prey.

The treatment of spider bites would be similar to that for centipedes and scorpions.

The popular notions that the spider is very poisonous when swallowed, and that its web possesses valuable medicinal properties, are probably equally exaggerated, if not altogether untrue. It is to be noted, however, according to Kirby and Spence, that Ulloa mentions a species of red spider, perhaps mite, called coya, in Popayan, that is very poisonous, the juices of its body when crushed, and coming in contact with the punctured skin, cause tumours and even death. This is no doubt an exaggeration, but it is probable that the juices of not only those, but some others are acrid and irritating, and it is therefore better not to crush them when they are detected on the person, but to brush or blow them away.

In India and the tropics, a streak of almost erysipelatous redness of the skin coming on rapidly, is attributed to a spider. No one has yet defined the species; it is possible that it may be due to an analogous species to that just referred to.

Acarina or Mites.—Some families of the acarina have individuals that have the power of causing considerable irritation by some secretion ejected on the surface, or injected into the wounds they make, in their burrowing operations with claws or mouth.

Tetranychus autumnalis or the Harvest Bug (Le Rouget), Leptus autumnalis.—Is brick red in colour, and very minute. It is bred on plants, but leaves them to fasten on animals, especially the human species. They fasten on the skin and adhere firmly, they

cause swelling and great irritation, severe itching when they are numerous, as they are apt to be. The intense irritation causes fever. The symptoms are not unlike the sting of a nettle. Erythema or even blistering is caused. They burrow under the skin rapidly. They are covered with hairs, and effect entrance into the skin with their claws or palpi, and thus give rise to the great irritation, which is probably aggravated by some acrid excretion. They are found in Britain, France, and other parts of Europe. There are varieties of them found in the tropics. One is mentioned as occurring in Brazil that causes intense irritation, also in Honduras and on the Mosquito Coast, and in the West Indies.

The *Tetranychus Tlalsahuate* is the name given to another form known in Mexico, which gives rise in the same way to great irritation, which continues for days. The mode of treatment is to extract the insect with a needle or point of knife, and then apply some soothing lotions.

T. irritans is the jigger of the Mississippi valleys; it causes great irritation in the same way.

Argas persicus.—A gamosid of this name, known also as the Teigne de Miana, venomous bug of Miana, well known in Persia. It is found in the houses, and it is said that its puncture produces serious symptoms—convulsions, delirium, gangrene, and even death. This is an exaggeration, though probably it is true that local irritation, and perhaps some constitutional disturbance, may be caused. It is blood-red in colour, spotted on the back, with white; feet yellow. Argas moubata, a native of Angola, is said to have much the same properties.

Argas talaje.—In Guatemala produces great irritation. It bites like an ordinary bug, and the punctures are followed by great irritation, swelling, and pain. It lives in holes in the bamboo walls, or such like crevices, and issues at night to attack the sleepers. They are called by the people talaje~~s~~.

The *Ixodidæ* or ticks are also the source of annoyance and irritation, by attaching themselves to the bodies of most animals; but there is no proof that they have any poisonous properties, so it is not necessary to allude to them further here.

Several others, *Anoplura* or lice, and *Sarcoptidæ* or itch mites, as is well known, cause great irritation and disease, but this is due to the mechanical, rather than the poisonous nature of the wound; the whole subject will be found detailed under the head of Parasites.

Hemiptera or Bugs.—Geocorysæ and Hydrocorysæ, land and water bugs.—Some of these have irritating properties, and also offensive odour; they have a suctorial mouth armed with a grooved instrument or rostrum for piercing the skin.

Cimex lectularius the bed bug, causes much irritation, and in some persons inflammatory action in the bitten part. The effects are transient.

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Notonecta, the water boatman, and *Nepa*, the water scorpion, common in pools of water in our islands, are also capable of inflicting a painful puncture.

Kirby and Spence speak of the *Cimex Nemorum* as causing nearly as much pain by its puncture as the sting of a wasp.

The wheel bug, *Reduvius serratus*, of the West Indies, gives an electric shock to the person it touches. St Pierre mentions a species of bug in the Mauritius whose bite is as venomous as the sting of a scorpion.

The *Benchucha*, or great black bug, of the pampas of South America, is more obnoxious, it is said, than the common bed bug.

Aphaniptera.—Pulicidæ, or Fleas.—There are several families of this order. It is only necessary to refer to Pulex irritans,—the universal common flea. It varies much in size and colour; some are almost black and very large, and are found on the sandy shores of the Mediterranean. There are many species, such as P. canis, P. musculus, P. vespertitinus, and others. Pulex penetrans of West Indies and South America, known also as the jigger or chigoe. It penetrates into the skin, and beneath the nails generally of the feet, causing great irritation. It will, if not extracted, deposit its ova, and thus give rise to severe irritation. The effects of the ordinary flea-bite are well known. No special treatment need be described. Prevention is better than cure. Though the irritation of flea-bites is chiefly due to the wound, there is reason to believe that this is aggravated by the presence of some irritating secretion.

Orthoptera are probably all free from venomous properties.

Diptera.—To this order belong the gnats. Mosquitoes, pipsas, sand-flies, gad-flies, are more or less dreaded for their bites. They have a proboscis composed of a grooved and flexible sheath, through which long, slender, sharp darts are protruded that pierce the skin, and no doubt inoculate some venomous secretion, though its nature is not known. They draw blood, raise white lumps or swellings; some, such as the pipsa of the Cossiah Hills, India, leave a livid spot of effused blood, that gives the person the appearance of a purpureal rash. They swarm in many countries, especially the tropics, generally near water. But they are not by any means confined to the tropics. Lapland swarms with them. The principal forms are the Culex pi~~pule~~s, iens
C. reptans, (common gnats) C. mosquito, Culex laniger, ~~the~~ (mosquito) the flies, C. tabanus. Some of these are formidable insects, and are insatiable blood suckers. The tsetze or timb, Glossina Morsitans of Africa, is one of the most remarkable. The bite of this poisonous insect is almost certain death to the horse, ox, or dog; though it appears not to trouble man more than to cause slight irritation, which has no further effect on him, though in a few days the animal sickens and dies.

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Oestrus, or the gad-fly, is troublesome to animals; but it does not, as a rule, molest man. Poisonous properties doubtful.

The *Tipulidæ*[1] are for the most part harmless, though one of them, the Hessian fly, Cecidomyia, is dreaded for its destruction of grain and wheat.

The *Simulium,* or Sand-fly.—The females only are irritating to man, the bite often giving rise to painful swellings. These insects, especially mosquitoes, are the pest of many countries, not only tropical, but even in Europe, and render it necessary that, to procure sleep, the person should be protected by a curtain.

The Pipsa is probably a simulium. It appears from the great irritation and the white hard swelling that follows the puncture of most of these insects, that some acrid secretion is injected into the wound.

In young full-blooded persons, especially recent arrivals in India or the tropics, the irritation caused by mosquito bites is often so severe as to give rise to violent inflammatory symptoms, resulting in suppuration or ulceration, and even gangrene, risking loss of limb, perchance of life. The application of common salt, solution of ammonia, soda, potash, lead, oil, ipecacuanha, alum combined with opium, allay irritation in the first stage. The more violent inflammatory symptoms are amenable to ordinary surgical treatment. Camphor, pulegium, lime-juice, applied to the skin are all regarded as preventatives. The term mosquito is rather vaguely applied to a great number of species of culex and simulium. In South America they are called Zãncudos, long-legs, moustiques, maringouins, temporaneos, black flies, mucha in India. These names are given to different varieties, all very similar in their effects on man in different parts of the world. The brulot, or burning fly, of West Indies and America, is one of this family, and it is so called because its bite is said to resemble the puncture of a red hot needle. The stomoxys calcitans, which is not unlike a common house fly in this country, is said also sometimes to cause local irritation. The gnats and mosquitos not only torment by their envenomed bites, but also by the buzzing and humming noise they make as they hover about their victims.

Hymenoptera.—A number of species that secrete poison are found among the different families of hymenoptera, the bees, wasps, ants.

They are distinguished from other insects by the presence of an ovipositor at the extremity of the abdomen in the female, which not only is used for depositing the eggs, but is in many species as a weapon for injecting venom. It consists of five pieces, two valves as a sheath, and three bristles which form a grooved sting. Through this groove formed by these three pieces the egg is

[1] A small species of Ceratopogon, one of the midges, is of this family, and is often annoying in our islands.

passed, and the poison flows, or is injected into the wound. Those that use it for that double purpose are known as the aculeate hymenoptera. In these the ovipositor becomes a sting by being connected with a poison gland at its base.

Formicidæ, the Ants.—Formica smaragdina and many others.—The sting of the ant causes considerable irritation, especially if the persons have been attacked by many. It has been suggested that formic acid is the irritating principle. There are several venomous varieties and species of ants, black and red, and they are of various sizes. Some of the larger forms in the tropics are capable of inflicting a very painful injury. Some ants have no sting, but eject a fluid which irritates the skin with which it comes in contact. They are sociable insects, and are apt to attack in numbers.

Vespidæ.—The Wasps, Hornets.—The females and workers of vespa are provided with a poison sac and sting.

Vespa vulgaris, a type of the tribe Crabro. It lives in communities, which are very numerous. Its sting produces much irritation, pain, and swelling, especially when inflicted on the face, or where the cellular tissue is loose. When they attack in numbers the consequences may be severe.

The *Apidæ*, or true bees, ~~or~~ the *Bombidæ* or humble bees, and have similar properties, and their sting has very much the same effect as that of the wasp.

The stingless honey bee, found both in the old and new world, is, as its name implies, harmless. Some of the parasitic Hymenopteræ also inject a poison into the wound made by their ovipositor. The best known instance is that of the genus Ophion. The genus Paripla also injects a poison in the same way, and probably others of the Ichneumonidæ do the same.

Many remedies of a simple nature have been recommended to allay the pain and irritation caused by wasp and bee stings. Vinegar, eau de Luce, ammonia, solution of soda or potash, oil, indigo, eau de Cologne, alum, and all those recommended in scorpion stings, have been vaunted as useful. In case of venomous stings, where constitutional disturbance is induced, stimulants or sedatives may be necessary, and as the sting is liable to be left in the wound it ought to be picked out. In cases of wasp or bee stings in the mouth or throat, which may happen when children bite a peach or other fruit that conceals a wasp, severe consequences may arise from the œdema that supervenes, and extends to the glottis. An emetic is useful. With the ordinary treatment of œdema, laryngotomy may become necessary. In other cases, should violent symptoms supervene, surgical aid may be required to relieve tension, or give exit to matter. Such untoward results, however, are happily rare.

Brink says that Mutilla coccinea, a native of the warmer parts of North America, is said to produce loss of sense within five

minutes after the infliction of its sting, and that life is in danger for some days afterwards.

Lepidoptera.—Burmeister says that the majority of insects furnished with a sting, as a means of defence, belong to the Hymenoptera. It is but recently that a stinging Lepidopterous insect has been found. The species is not mentioned.—(*F. Smith.*) The bee moth of the Cape of Good Hope is said to defend itself with a sting.—(*Kirby, Spence.*) Though the majority of the perfect insects of this tribe are harmless, some of the caterpillars appear to be possessed of very irritating properties, residing in the fine hairs with which they are cased, and which being sharp and brittle, break off and remain on the skin with which they come in contact, certainly causing irritation mechanically; but also probably by the presence of some acrid substance concealed within the hairs. For instance, in Ceylon, a greenish hairy caterpillar, longitudinally striped, frequenting the leaves of *Hibiscus populneus,* probably of the genus Bombyx, which, alighting on the skin, causes as much irritation as the sting of a nettle. The larvæ of Neæra lepida, which feeds on the jasmine flowering Carissa, have similar properties. It is short and broad, of a pale green, with fleshy spines on the upper surface, each of which is charged with venom that occasions acute suffering. The larvæ of the genus Adolia are also armed with venomous hairs. There are probably many others. One, not uncommon in certain trees in the terai of the Himalaya, is a dark-coloured hairy caterpillar, that is apt to fall on people below and cause intense irritation. It is known as the Komlah, but the moth that produces it is not known.

Neuroptera, apparently, are free from venomous properties.

Coleoptera.—None are known to be injectors of venom, but there are several that have acrid secretions capable of exciting great irritation and inflammation, raising blisters, and if absorbed causing painful strangury and great urinary irritation. Such are Mylabris Cichorii of India, Cantharis or Lytta, or Meloe vesicatoria, Lytta gigas of Senegal, Lytta vitata of America, and Lytta ruficeps in Chili.

The *Brachinus,* or bombardier beetle, seems also to be provided with an acrid secretion, which it ejects against its prey; it is not, however, obnoxious to man. The nature of the action of the Cantharis is so well known that it is needless to describe it here.

Crustacea have no poisonous representative.

Vermes has no venomous species. The Leeches: Hirudo. Many species inflict a wound which in hot, damp climates may give rise to inflammation, causing a troublesome sore, but there is no reason to believe that they possess any venomous properties.

Echinodermata.—The long sharp pointed spine of some of

the Echinids are capable of inflicting painful punctured wounds, but they convey no true venom into the wound. Whether, as in the case of some spiny fishes, there may be an irritating mucous secretion inoculated is uncertain.

Cœlenterata. — Some of the Medusæ—jelly fish — have the power of stinging. The poison apparatus is placed in certain tubercles on the surface. These contain a collection of granules, amongst which are small vesicles. Within these corpuscles or nematocysts a spiral thread is found, which bursts out on pressure. These corpuscles are found in the mucus exuded by the creature, and to these is attributed the urticating power it possesses. There are several stinging species, some are found on our own coasts, others in other seas. It is the larger forms generally that are venomous, the small ones, if they are so at all, having no effect on man. Cyanea capillata of our seas, says Professor Forbes, is a most formidable creature, and the terror of bathers. It has a broad tawny disk, and a long train of ribbon-like streamers floating after it; it flaps its way through the waters, and whatever comes in contact with these trailing trains soon writhes in torture, the effect produced being not unlike that of the nettle.

Physalea pelagica, Portuguese man-of-war, has similar properties. It causes severe and stinging pain, extending up the limb, with feverishness, which has been known to continue for some hours, white wheals forming on the skin, like urticaria. The application of vinegar or olive oil is said to remove the unpleasant symptoms. Several of the medusæ possess these properties, and hence they have received the name of Acalephæ, or sea nettles.

There has been difference of opinion as to the functions of the thread cells. Some think that they are the agents by which the poisoning is produced, by penetrating the tissues. The threads being armed with a sharp barbed spine inflict the puncture into which the poisonous secretion is injected. Others reject this explanation. Allman thinks that there is penetration; the sudden ejection of a barbed sac against the soft tissues of the prey, which if these be soft enough allow the point of the sac to penetrate as far as the roots of the barbs, the act is followed by the ejection of the filament, for which the barbed sac has opened a passage.

He thinks it is impossible that the effects which follow can be produced simply by mechanical irritation, but that some virus is injected. That the creature can sting there can be nodoubt, though the exact process by which it is effected may be uncertain.

The *Actiniæ,* or sea anemones, and the hydroid polyps, appear to possess a similar power, and are provided also with thread cells. They appear to be able to paralyze the small marine creatures that come within their grasp, or to cause urtication of the human skin when brought in contact with their tentacles.

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The *Sagartiadæ* furnish examples of sea anemones with this property. The effects, however, of any of them are transient. In some parts of Europe or Norway the Acalephæ have been used therapeutically as counter-irritants, and being brought in contact with the patient by immersing him in a salt-water bath filled with these creatures.

It is by no means pretended that in the preceding description the subject of venomous animals has been exhaustively treated, or that all the forms of animal life so endowed have been described. The object has been to point out the principal forms, and to indicate generally the mode of dealing therapeutically with the effects of the venom.

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The Size of the Indian Tiger

In a book recently published entitled "Thirteen Years Among the Wild Beasts of India," by Mr. G. P. Sanderson, of Mysore, at pages 272, 273, the following remarks occur regarding the size of the tiger, and in reference to certain measurements of that animal given in a small volume entitled "The Royal Tiger of Bengal: his Life and Death," published in 1875.

The author (Mr. Sanderson) says,—"Regarding the size of the tiger, once a much disputed point, all careful observers are, I believe, agreed in accepting Dr. Jerdon's view ('Mammals of India') as thoroughly correct. He says, 'The average size of a full-grown male tiger is from 9 to $9\frac{1}{2}$ feet,' but I fancy that there is little doubt that occasionally tigers are killed 10 feet in length, and perhaps a few inches over that; but the stories of tigers 11 feet and 12 feet in length, so often heard and repeated, certainly require confirmation, and I have not myself seen an authentic account of a tiger that measured more than 10 feet and two or three inches. I know," continues Mr. Sanderson, "two noted Bengal sportsmen who can each count the tigers slain by them by hundreds whose opinions entirely corroborate Jerdon. My own experience can only produce a tiger of 9 feet 6 inches and a tigress of 8 feet 4 inches as my largest. Of course writers start up now and again, as the author of the 'Royal Tiger of Bengal' did two years ago, and give us something like the following :—'The full grown male Indian tiger may be said to be from 9 to 12 feet or 12 feet 2 inches, the tigress from 8 to 10 feet, or perhaps in very rare instances 11 feet in length.' It is only fair to the author to state, however, that in the next paragraph he looks with doubt upon Buffon's tiger of 15 feet, and would only with greater hesitation accept the recorded statement that Hyder Ally presented a tiger to the Nawab of Arcot that measured 18 feet.

A portion only of the paragraph in my book is quoted; the most important, the first part, being omitted; it is as follows :— "The statements as to the length they (tigers) attain are conflicting, and errors are apt to arise from measurements taken from the skin after it is stretched, when it may be 10 or 12 inches longer than before removal from the body. The tiger should be measured from the nose to the tip of the tail as he lies dead, before the skin is removed. *One that is* 10 *feet by this measurement is large, and the full-grown male does not often exceed this, though no doubt larger individuals* (*males*) *are occasionally seen; and I have been informed by Indian sportmen of reliability that they have seen or killed tigers over* 12 *feet in length.*"

This account of the size of the tiger really, therefore, substantially agrees with Dr. Jerdon's, except that he says, "The stories of tigers of 11 feet and 12 feet in length, so often heard and repeated, certainly require confirmation." This confirmation is supplied. The following examples may be adduced :—

Lieut.-Col. G. Boileau killed a tiger at Muteara, in Oude, in 1861, that was over 12 feet, the skin, when removed, measured 13 feet 5 inches.

Sir G. Yule, K.C.S.I., has heard once, at least, of a 12-foot tiger fairly measured, but 11 feet odd inches is the largest he has killed, and that twice or thrice.

Col. Ramsay killed a tiger in Kumaon, 12 feet. I have myself seen and killed tigers over 10 feet, and have notes of some: one, for example, killed in Purneah, in 1869, 10 feet 8 inches in length.

Gen. Ramsay mentions the skin of a tiger partly killed by himself near Benares that measured over 12 feet. This had no doubt been stretched, but it was a very large tiger.

Col. J. Sleeman does not remember having killed a tiger

measuring more than 10 feet 6 inches in the skin. He saw the skin of one at Dinagepore, over 12 feet in length; this was also no doubt stretched. Col. J. Macdonald has killed a tiger of 10 feet 4 inches. He says: "I do believe tigers have exceptionally reached 12 feet."

The Hon. R. Drummond, C.S., killed a tiger 11 feet 9 inches in length before being skinned.

Col. Shakespeare killed a tiger of 11 feet 8 inches.

In regard to the allusion to Buffon's tiger of 15 feet, and Hyder Ally's of 18 feet, I refer to but to express my distrust of them.

It is needless to adduce further evidence. I repeat that though male tigers over 10 feet may be uncommon, they do *occasionally* (and I said no more) attain the greater size.

June 17 J. FAYRER

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NATURE Nov. 7. 1878

SIZE OF THE TIGER

IN a work on the tiger, published in 1875,[1] I made the following remarks in reference to the size of the animal:—

[1] Royal Tiger of Bengal, pp. 29, 30.

"The size of the tiger varies: some individuals attain great bulk and weight, though they are shorter than others which are of a slighter and more elongated form. The statements as to the length they attain are conflicting and often exaggerated; errors are apt to arise from measurements taken from the skin after it is stretched, when it may be 10 or 12 inches longer than before removal from the body. *The tiger should be measured from the nose along the spine to the tip of the tail as he lies dead on the spot where he fell before the skin is removed. One that is* 10 *feet by this measurement is large, and the full-grown male does not often exceed this*, though no doubt larger individuals (males) are *occasionally* seen, and I have been informed by Indian sportsmen of reliability that they have seen and killed tigers over 12 feet in length. The full-grown male Indian tiger, therefore, may be said to be from 9 to 12 feet or 12 feet 2 inches, the tigress from 8 to 10 or *perhaps in very rare instances* 11 *feet* in length, the height being from 3 to 3½, or, rarely, 4 feet at the shoulder."

The point I now especially desire to elucidate as it has been the subject of discussion, but is one that has never yet been satisfactorily settled, is the greatest length the tiger attains.

Jerdon and others say that the average size of a full-grown male tiger is from 9 to 9½ feet in length, and that he has not seen any authentic account of a tiger that measured more than 10 feet and 2 or 3 inches.

I agree with Jerdon that 9 to 9½ or 10 and 2 or 3 inches are the lengths attained by the majority of tigers met with; but the occasional occurrence of tigers of upwards of 10 feet 2 or 3 inches (the authenticity of which is doubted) is attested by the evidence of several competent and reliable observers, who are quite aware that the measurements should be those of the animal as he lies where he fell, and before being despoiled of his skin, and that measurements of the skin after removal are deceptive.

I have taken some pains to ascertain the views of those who are most likely to be well informed on the subject, and I add the results of my own observations during considerable experience in Bengal, Oude, and Nepal; it would seem that the evidence wanted by Jerdon is forthcoming, and that tigers above 10 feet 3 inches, 11 feet, and even 12 feet, *are* occasionally met with, and *have been accurately measured.*

I may remark that it is very possible that like boars, and other animals, they may differ in size according to locality, food, and other conditions of life; and that such being the case, it is probable that tigers of one province or district may exceed those of another in size. Indeed I am inclined to believe that such is the case.

and that therefore those who contend for the larger may be equally right with those who maintain the smaller measurements. I am rather inclined to agree with Mr. C. Shillingford, who suggests the possible progressive degeneration of the tiger; what, certainly, according to some, obtains in the case of stags in the continuously over-shot deer forests of Scotland, may also be going on in the tiger of the much-hunted jungles of India. However this is a mere suggestion, but be it as it may, the inches of the big tiger are, I think, an ascertained fact, for it can hardly be maintained that the authorities who vouch for it are either mistaken or misinformed, or that they do not know how to measure a tiger accurately.

Sir G. Yule, K.C.S.I., Bengal Civil Service, says: "I never had the luck to fall in with a 12-foot tiger; 11 feet odd inches I have killed twice or thrice. I have heard once, at least, of a 12-foot fellow fairly measured, and I cannot see why there should be any doubt as to the occasional occurrence of such exceptions to the general rule."

Col. George Boileau, Bengal army, says he killed a tiger at Mutearah, in Oude, that was well over 12 feet. He writes:—"I can speak positively as to the size of the tiger—his length was well over 12 feet before the skin was removed. He was, of course, quite an exceptional size, and unequalled, so far as my own experience goes, which extended over seventeen years of constant hunting after the species. My own experience of the size of tigers is that, in the female, the size runs from 8 feet to 9½ feet—the latter exceptionally large; in the male, from 9 feet to 11 feet; a well-grown adult tiger is seldom less than 10 feet in length. I speak of hunting-grounds frequented by myself (chiefly Oude and Nepal Terai), for no doubt the size varies according to locality, abundance of food, and its reverse must of course produce their usual results."

Col. Sleeman, Bengal army, says:—"I don't remember having killed a tiger measuring more than 10 feet 6 inches in his skin, but I have seen skins of tigers 11 feet 6 inches in length, and once, at Dinagepore, in Bengal, over 12 feet. I have the skin of the largest tiger I think I ever saw, and it measures 12 feet 2 inches. This tiger was killed near Jubbulpore, in Central India, by an old Thakoor sixty years of age, and I preserve the skin as a trophy of native pluck and vigour in age."

The skins above alluded to were, no doubt, stretched, and therefore do not prove more than that they were taken from large animals, which may have been probably between 10 and 11 feet in length!

Col. J. Macdonald, Bengal army, Revenue Survey, says:—"The largest tiger I have ever measured out of seventy was 10 feet 4 inches, and out of all these only three have touched 10 feet. But I do believe that tigers have exceptionally reached 12 feet." "The skin of a tiger ten feet in length, as he lies dead, would stretch to nearly twelve feet, but after curing it returns to nearly its normal size. I have often measured the distance between a tiger's marks on the ground; average and

large animals are from 4 feet 4 inches to 4 feet 8 inches, well! I once found marks 5 feet 10 inches apart, this must have been the mark of a gigantic beast—the breadth of the impression of the fore paw, and the depth of the impression, showed his great size and weight. This was in the Sunderbunds. Mr. M., of Morel-Gunge, told me that once when going through a narrow creek in the Sunderbunds, he saw a stupendous brute, far exceeding in size anything he had before seen in tigers or could have believed possible. The heaviest male tiger I have seen weighed 448 lbs., the lightest, a tigress, 242 lbs."

The Hon. R. Drummond, B.C.S., late Commissioner, Rohilkund, says:—

"I have never seen a 12-foot tiger. The largest I ever shot was 11 feet 9 inches as he lay on the ground immediately he was shot, and before being padded. I measured him because I was struck with his large size."

F. B. Simson, Esq., B.C.S., says:—"I have killed or been at the death of about 180 tigers; I never actually handled one 11 feet long, but I fully believe that they reach that length occasionally, and every now and then a monster is found. The largest skins by far I have seen, came from China. I give you the exact measurements of several I have killed and fairly measured immediately after death, and before they were padded with dates:—

			Tigers' length.		Height at Shoulder.	
			Ft.	In.	Ft.	In.
1855	October	15	9	5	3	6
1856	February	13	10	4	3	8
,,	,,	11	10	11	3	7
1858	March	15	9	1	—	
			Tigresses's length.			
1855	October	14	8	8	3	3
,,	,,	13	8	5	3	5
,,	,,	19	8	11	3	5
,,	November	22	8	10	3	3
1856	October	6	9	4	3	10½
1857	February	8	8	10	3	4

"All these were killed on the churs of the Megna, between Backergunge and Noakhally. In later years I killed tigers in Purneah, Docca, Mymensingh, and Assam, but their exact dimensions were not recorded. I do not remember any exceeding generally in size the measurements I have given. I once killed a tiger who stood almost 4 feet at the shoulder.

"I have often been referred to about hogs. I have taken about 900 first spears, and hunted in nearly every zillah in Bengal, but I never speared the boar that would not have walked under a standard of 3 feet 3 inches. This statement has disappointed many; but the facts are at your service, and you may use my name to authenticate them when you choose."

Major-General Sir H. Green, K.C.S.I., C.B., Bombay, says:—"The biggest tiger I was ever at the killing of was in 1848, near Surat, and it measured, *pegged out*, 12 feet 4 inches. I heard by last mail from Claude Clerk at Hyderabad, who said he had just killed, to his own gun, the biggest tiger *he* had ever seen, as it measured 11 feet 6 inches *before* skinning."

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Sir H. Green also writes:—"I inclose a letter from Col. Stewart regarding tigers, and I have made many inquiries about them since, and there can be no doubt that a 12-foot tiger is very rare, although I have no doubt there are instances of that size having been exceeded. I find, by reference to my journal, that I have a record of some I have killed, and that the one I mentioned as 12 feet 4 inches, pegged out, measured, *before* skinning, 11 feet 11 inches. Measures before skinning:—

11 feet 11 inches.
10 ,, 11 ,,
9 ,, 9 ,,
9 ,, 6 ,, .—Tigress.
9 ,, 3 ,,
8 ,, 6 ,, .—Tigress; pulled down my elephant."

Col. D. G. Stewart writes:—"I have never seen or heard of a *bona fide* 12-foot tiger, *i.e.*, as he lay in his skin. The largest I ever saw or killed was, as he lay, 11 feet and $\frac{1}{4}$ inch. I have personally measured eighty tigers or more of my own shooting, and the dimensions I have given are those of the largest of my victims. I saw a skin in San Francisco, of a Chinese tiger, which might have been 12 feet long in life. I never saw anything Indian to approach it. The Chinese skin was fairly treated, had breadth as well as length, the fur was long and soft. The average size of large males in the Central Provinces I found to be 10 feet 6 inches to 10 feet 8 inches; the tail had a good deal to do with the last two or three inches. The largest tigress I killed was, I think, 9 feet 3 or 4 inches, but I speak from memory. Of two males the girth of the fore-arm of one was 48 inches, the average being 32 to 34 inches. One of the most remarkable measurements is that of the tail where it joins the carcass. I have repeatedly found it in males 12 inches."

The Hon. Sir H. Ramsay, K.C.S.I., C.B., Commissioner, Kumaon, writes: "I have always understood that Bengal tigers are larger than ours in the north-west. The largest tiger I ever killed measured 10 feet 5 inches, and I consider anything above 10 feet a large tiger; a tigress very seldom gets beyond 9 feet. I have heard of Bengal tigers measuring 12 feet. G. tells me his father, a Bengal civilian, shot a tiger that measured 12 feet 4 inches, but I never shot in Bengal."

Mr. C. Shillingford, indigo-planter, Purneah (with whom I have shot many tigers) says: "My experience extends over thirty-five years, during which I have shot more than 200 tigers. In 1849 I shot one of the largest tigers I have ever seen, with a party of four. He measured, *as he fell*, 12 feet 4 inches, was very old, and his marks had become faint; the hair was short, like that of a greyhound. I shot another tiger which measured, as he fell 11 feet 10 inches, and another in 1855, 11 feet 4 inches; several of 10 feet 6 inches and 10 feet. The majority of male tigers seldom exceed 10 feet, and many attain only 9 feet 8 inches or 9 feet 10 inches."

Cumming says he has shot a few over 11 feet, and gives three instances—one at Rohinipore, 11 feet 4 inches: one at Kaliastrich in 1865, of 11 feet 2 inches; and another

at Gour in 1871. My nephew has also shot one or two over 11 feet.

I think these very large tigers are rare and are only to be found in the Ganges churs; I am also inclined to believe that they are degenerating, as I have not shot large ones for several years: or it may be that there is a keener set of sportsmen now-a-days, and no sooner a tiger is heard of than he is shot. The tigresses are seldom over 8 feet, though I have known some that attained 9 feet to 9 feet 6 inches. Cumming says he has seen the claw-marks of a tiger on a tree 18 feet high. The men who are difficult to convince about the large tigers are those who have shot them in hills and rocky places, and those tigers are of a different class and seldom grow large."

Major Bradford, C.S.I., of the Political Service, says: "10 feet 5 inches was the largest tiger I ever saw, but I sent the question to Martin and inclose his reply and the inclosures to it. I remember hearing of this immense tiger White speaks of."

Col. C. Martin, C.I. Horse, says he shot a tiger at Putulghur 10 feet in length, and alludes to a large tiger shot near Goona by Mr. White, which was measured by Mr. Angelo, and is described as follows by the latter gentleman: "I can remember, beyond all doubt, the length was 12 feet 4 inches from tip of nose to tip of tail; 2 feet 2 inches from ear to ear! The direct breadth of wrist 8 inches, spread of foot 10 inches, heel to withers 4 feet, and the tail was 3 feet in length."

These measurements were recorded in the *Delhi Gazette*, but there is some doubt as to their accuracy; so that they may hardly be regarded as proving more than that the tiger was a very large one. Col. Martin says, in a subsequent letter, "W.'s tiger, which I had always thought 12 feet 4 inches, is no longer to be relied on for scientific inquiry, though it probably exceeded 10 feet."

Lieut. James Ferris, B. Army, says: "I have had a good deal of experience, as I have shot in the Central Provinces, and for several years in Oude and Nepal. The largest tiger I know of was shot by Wilkinson, in 1873, in Nepal, he measured 10 feet 4 inches from tip of nose to tip of tail. Wilkinson, who has shot more tigers than most men in India, told me this was the largest he had ever seen; the largest tiger I ever shot myself I got the same season in Nepal; he measured 10 feet 2 inches, he was considered a monster. The tigers in Lower Bengal may be larger, but in the Central Provinces they are certainly smaller; it depends a great deal on how the tiger is measured."

Gen. Ramsay, Bengal Army, says: "The largest tiger I ever saw I shot in conjunction with Col. Stewart, a fine old sportsman, who died many years ago at Benares. The tiger was not found for some days, when he was discovered dying from loss of blood and starvation. The skin was removed, and measured 12 feet from the nose to end of tail." This skin was no doubt stretched. "A tiger of 10 feet 6 inches is a very fair sized tiger. Tigresses seldom grow so large." General Ramsay adds: "My friend Col. H. Shakspeare writes me that 'the two

largest tigers he ever killed were, when brought in and measured, 11 feet 8 inches and 11 feet 6 inches respectively—the latter a tigress.' He does not think he has ever seen larger ones. There probably are tigers that measure 12 feet or more, but they would be very rare."

Mr. F. Buckland has kindly given me the following extract from his "Curiosities," 1866, in regard to a tiger shot by Col. Ramsay, who says that he and Major B. shot a tiger at Huldwana, in the Kumaon Terai, that they estimated to be about twelve years of age, and was of the following dimensions :—

	ft.	in.
Length from nose to end of tail … …	12	0
,, of tail … … … … …	3	9
Height from heel to shoulder … … …	3	7
Girth of body behind shoulder … … …	5	3
,, forearm … … … …	2	10½
,, neck … … … … …	3	7
From ear to ear … … … … …	1	6½
Length of upper canines … … …	0	3
,, lower ,, … … …	0	1¾
,, claws … … … … …	0	3

On referring to some of my own tiger shooting notes I find that I have recorded the following measurements :—

Oude Terai, 1855

	ft.	in.
1. Tiger … … … … … …	9	5
2. ,, … … … … … …	8	0
3. Tigress, very large, pregnant with five cubs, measurement not preserved.		
4. Tiger … … … … … …	10	0
5. Tigress, large, but measurement lost		
6. Tiger … … … … … …	9	0
7. Tigress … … … … …	8	10
8. ,, … … … … …	8	11
9. ,, … … … … …	8	9
10. Tiger, cub … … … … …	5	9
11. ,, … … … … … …	9	7
12. ,, … … … … … …	9	11

Oude Terai, 1857

	ft.	in.
13. Tigress … … … … …	8	0
14. Tiger … … … … … …	8	3
15. Tigress, with three cubs … … …	8	10
16. Tiger … … … … …	Lost measurement.	
17. Tigress … … … …	ditto.	
18. ,, … … … … …	ditto.	
19. Tiger … … … … …	ditto.	
20. Tigress, very large, pulled G.'s elephant down, lost measurement.		
21. Tiger killed in Hangua (drive) from a tree, very large.		

Maldah, Bengal, 1870

22. Tigress } 23. ,, } … … … …	Measurements lost.	

Ulwar

24. Tiger … … … … …	Measurement lost.	

Purneah, Bengal, 1869

25. Tigress … … … … …	8	2
26. Tiger … … … … … …	10	0
27. Tigress … … … … …	8	7

28.	,,	... ... Measurement lost.	
29.	,,		
30.	,,		
31.	Tiger	10	8
	Purneah, 1871		
32.	Tigress	9	0
33.	,, ...	7	6
34.	,, ...	7	8
35.	,, ...	8	8
	Oude and Nepal, 1871		
36.	Tigress	8	9
37.	Tiger	9	7
38.	Cub	5	5
39.	,, ...	5	8½
40.	Tigress	8	7
41.	,, ...	8	6
42.	Tiger	9	6
43.	Tigress	8	8
44.	Tiger	10	6
45.	,, ...	7	0
46.	Small cub		
47.	Tiger	9	4
48.	Tigress (I killed her with a single bullet in the neck)	8	11
49.	Her three cubs.	6	11
50.	... ...	6	5
51.	... ...	6	10

These are all the notes I can lay my hands on at present. The largest tiger was 10 feet 8 inches, the largest tigress, 9 feet. Both were Bengal Purneah tigers. My own experience, therefore, confirms so much of Jerdon's estimate as that the tiger averages from 9 to 9½ feet, the tigress between 8 and 9 feet; but that which he and others doubt, viz., that tigers do occasionally attain the length of upwards of 10 feet 3 inches and even 11 feet or 12 feet, and the tigress up to 10 feet or even more, is conclusively attested by the evidence of the gentlemen whose statements I have quoted.

I am indebted to Sir Dighton Probyn for an interesting letter from Capt. Gerard, of Goona, a high authority on Indian felidæ. He expresses his belief that tigers seldom if ever exceed Jerdon's measurements, a tiger of 10 feet 1 inch being the length of the largest he has ever killed or seen. He refers to examples of large tigers described by various observers, but he doubts the accuracy of the measurements, which he thinks may have been unintentionally exaggerated. His own experience is very large, his accuracy as an observer well known, and his opinion consequently of much value; but it is hardly sufficient to invalidate that of others who are no less competent to note and record facts, and who certainly give a greater length, as the extreme growth of the tiger, than that within which Capt. Gerard limits him. The matter then stands thus: Mr. C. Shillingford, Col. G. Boileau, and Sir C. Reid,[1] vouch for tigers of over 12 feet. The same

[1] Since writing the above I have been informed by General Sir C. Reid, K.C.B., Bengal Army, that he has shot, and measured before the skin was removed, in the Dhoon a tiger of 12 feet 3 inches.

gentlemen, with Sir H. Green, Sir H. Yule, the Hon. R. Drummond, Col. D. G. Stewart, Mr. Cumming, and Col.

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Shakespeare vouch for tigers of 11 feet and upwards. The above, with Col. J. Sleeman, Sir Joseph Fayrer, Mr. B. Simpson, and the Hon. Sir H. Ramsay vouch for tigers of 10 feet 5 inches and upwards, all from measurements taken before the animals were skinned. Unless these gentlemen, all of whom are accustomed to shoot and measure tigers, were *mistaken*, the question of length may, I think, be regarded as decided beyond dispute.

In conclusion, after thanking sincerely those gentlemen who have given me information derived from their own experience, I would just say that the mere length of a tiger is not necessarily and indication of his real size. The tail is included in the measurement—so tiger hunters have ruled that it shall be—but the tail is a somewhat variable element; in some it is long, in others short, and it is quite possible that a 9-foot 6-inch tiger with a short tail may be heavier, stronger, and larger than a 10-foot tiger with a long tail. No doubt anything over 10 feet is very large, and those of 11 or 12 are rare and exceptional, even though part of their great length may be assigned to an immensely long tail. But I think that, while making all allowances for errors of measurement—which doubtless are not uncommon, though unintentional—there is still sufficient evidence from accurate measurements to show that tigers may exceed 10 feet 3 inches, and that in a few—perhaps rare and exceptional instances—do exceed even 11 and 12 feet.

J. FAYRER

2 4 5

DESTRUCTION OF LIFE IN INDIA BY POISONOUS SNAKES

IN January, 1870, being then in Calcutta, I collected statistical information which afforded proof that the loss of human as well as animal life in India from the bite of venomous snakes was very great; and as it seemed to me that this ought to be, to a great extent, preventible, I extended my investigations with the view of obtaining accurate information as to the characters and peculiarities of the venomous snakes themselves, the localities in which they most abound; the *modus operandi* of the poison; the circumstances under which the bites are inflicted; the value of any known remedies in the treatment of those bitten, and what measures might possibly be devised for diminishing this serious evil.

After a long and careful investigation of the whole subject, I drew up a detailed report, containing the results of my inquiry, and presented it to the Government of India, with a request that, when published, it should be distributed throughout India, among civil and medical officers, with a view of enabling them to take measures for the protection of human life, and the destruction of the creatures which caused such frightful mortality. I also endeavoured to point out the mode in which the poison destroys life, and to indicate such rational measures as might be of service in the treatment of those bitten.

I am not aware how far the advice I then tendered has been acted on, but I am glad to find, by a recent resolution published in the *Gazette of India*, that some progress is being made, and that the mortality of 1881 has been somewhat less than that of 1880, from this cause, and that this desirable result is due to the measures that have been taken by Government to procure the destruction of the poisonous snakes.

From the returns furnished to me at the instance of Government in 1870, for the year 1869, I made out that the human deaths from snake-bite were as follows in—

Bengal, including Assam and Orissa	6645
North-West Provinces	1995
Punjab	755
Oude	1205
Central Provinces	606
Central India	90
British Burmah	120
Total... ...	11,416

These were the only returns received, and represent not much more than half of the whole area, but the total, large as it is, cannot be regarded as the real mortality in these provinces, as the information from which the records were framed being probably only partial and imperfect, it rather under-rates than exaggerates the mortality. I expressed a belief that if systematic registration were adopted, the number recorded would prove to be larger, whilst, if information were gathered from the whole of Hindostan, it would be found that not less than 20,000 persons are destroyed annually by snakes.

Certain suggestions were made as to measures for identification, destruction of venomous snakes, and for registration of deaths. These would appear, from the terms of the resolution above referred to, to have been partially adopted, with the result of causing some diminution of the evil. I pointed out that the snakes which are so destructive to life are the cobra, the bungarus or krait, the echis, and the daboia or Russells' viper, all of which are most conspicuous snakes, and easily identified. There are others, such as Bungarus fasciatus, Ophiophagus elaps, which are dangerous, but comparatively rare, and seldom bite men, whilst the hydrophidæ being confined to the sea or estuaries, are, though very poisonous, not so dangerous to man, and the trimeresuri, which are both uncommon, and at the same time are not so deadly as to endanger life. All these are depicted in coloured figures taken from life, which renders their identification simple and easy.

I further remarked that, "meanwhile there exists the obvious necessity of endeavouring to prevent the numerous fatal accidents by making generally known the appearance and habits of the poisonous snakes, and by instituting rewards for their destruction. With a plain description and a faithful representation of each species in colours, every district, medical or police officer, would be able at once to distinguish the venomous from the innocent snakes, and thus knowledge enough, at least for all practical purposes, might be imparted to intelligent native subordinates, to enable them to recognise the poisonous snakes. By offering a larger reward for these only, their numbers would soon diminish, and the people would be made acquainted with the characters that distinguish the venomous from the harmless snakes, and would learn to avoid them. Thus only, I believe, can the evil be remedied, so long, at all events, as the mode of life among the lower and agricultural classes remain what it now is. I would suggest that magistrates, district and police officers, and civil surgeons be authorised to give the following rewards for poisonous snakes :—

	Annas[1]
Cobra	8
Bungarus cæruleus	6
Bungarus fasciatus	4
Ophiophagus	8
Russell's Viper	8
Echis	4
Trimeresurus	2

The sum disbursed would no doubt be large, but the results in the saving of life and destruction of snakes would compensate for the expenditure."

Such was the state of things when I left India in 1872. The Government of India then, at my instance, appointed a commission to continue the inquiry which I had commenced three or four years previously. This resulted in several valuable reports by Drs. J. Ewart, A. Wall, and Mr. Vincent Richards, whilst, in conjunction with Dr. Lauder Brunton, F.R.S., an investigation into the nature of the physiological action of the virus was continued here by me,

[1] Eight annas represent one shilling.

the results of which have been published in the *Proceedings* of the Royal Society in 1873, 1874, and 1875. Meanwhile the evil continues, and it is probably within the mark to say that, since the subject came under consideration in 1870, 150,000 to 200,000 human beings, to say nothing of domestic animals, have been destroyed by snake bites.

The subject has often received the most anxious consideration of the Indian Government, and a variety of measures have been resorted to, not without a certain measure of success; but it is my belief that not until a system of organised, determined, and sustained efforts for the destruction of the snakes is adopted and carried out on the lines suggested in my report, will the evil be fairly grappled with and overcome. The present resolution shows that the matter is again receiving some consideration, and there is good reason to believe that if the measures be prosecuted with energy and determination throughout India, good results will follow. But I repeat it is only by the *destruction of the snakes* that the evil can be mitigated. Something may be expected from the people themselves as their knowledge of the subject increases, as they become more familiar with the appearance or character of the venomous as distinguished from the harmless snakes, and as they gradually become convinced of the futility of all antidotes charms or spells to protect them; or should they ever alter their present mode of living in huts which have the floor on the ground surface, to huts with raised floors—a consummation devoutly to be wished, not only on account of snakes, but of malaria—but hardly likely to be realised.

For the purpose of hunting out and destroying the evil it is absolutely necessary that a fixed system of rewards should be established, and that in every district there should be an organised body of men whose duty it would be, under proper supervision, to seek out and destroy the snakes, receiving a recompense according to the importance and number of the snakes killed. Such men are to be found among certain castes, and with the aid of descriptions and coloured drawings, such as now are available, there need be no great difficulty in carrying out this much-to-be-desired object. That such a project would be costly is true, but can that cost be considered excessive if it save thousands of lives of men and valuable animals? There can be little doubt that wherever such a system has been even partially carried out, it has been effective; it needs but combined effort to make universal, that which hitherto would appear to have been but partial success.

From the tenor of the Government resolution referred to, it seems as though an organised scheme for the destruction of venomous snakes, as well as dangerous wild animals, is now likely to be generally adopted in India, and should it be so, there is good ground for hope that the great mortality will decrease—to quote from a former paper on this subject, I would repeat: "Rewards should be offered freely for venomous snakes only. This, if steadily carried out under some responsible official, would soon diminish snakes and deaths from snake-bite; and I earnestly protest against the opinion expressed by some Indian authorities, that such rewards are useless—useless

they may have been, and will continue to be, if distributed without discretion for snakes not poisonous. If this method of dealing with the matter—and who can deny its importance—be adopted (but it must be done willingly, and not with the foregone conclusion that it will fail), I am certain that, as part of a comprehensive scheme for the destruction of noxious animals generally, it will succeed."

The following is the purport of the resolution of November 8, 1882, which shows that in 1881 the number of deaths caused by snake-bite, of men and animals, contrasted favourably with that of the previous year, 1880.

The statement appended to this resolution shows in detail for each province the number of persons and cattle killed by wild animals and snakes, and the number of wild animals and snakes destroyed, with the rewards paid for their destruction during the year 1881, as compared with the previous year. The figures are summarised in the following tables :—

Number of Human Beings and Cattle Killed by Snakes

	Persons killed.		Cattle killed.	
	1880.	1881.	1880.	1881.
Madras	1,182	1,064	227	273
Bombay	972	1,024	89	191
Bengal	10,064	9,208	1,248	154
North-Western Provinces and Oudh	4,723	5,010	221	317
Punjab	681	744	78	69
Central Provinces	901	985	39	26
British Burma	149	135	194	150
Coorg	3	Nil	Nil	Nil
Assam	211	189	57	16
Hyderabad Assigned Districts	125	197	383	836
Ajmere-Merwara	49	54	Nil	Nil
Total	19,060	18,610	2,536	2,032

Snakes killed and Rewards Paid

	Destroyed. 1880.	Rewards. 1880. Rs. a. p.	Destroyed. 1881.	Rewards. 1881. Rs. a. p.
Madras	Nil	Nil	Nil	Nil
Bombay	177,078	6,922 3 6	207,113	6,214 0 0
Bengal	23,201	3,733 3 6	19,282	3,430 5 0
N.-W. Provinces and Oudh	1,029	10 2 0	1,142	56 5 3
Punjab	9,126	635 5 0	22,279	1,587 4 0
Cent. Provinces	866	336 6 0	1,493	562 8 0
British Burma	997	2 0 0	2,990	27 0 0
Coorg	58	Nil	16	4 0 0
Assam	202	Nil	300	34 0 0
Hyderabad Assigned districts	158	23 14 0	332	45 8 0
Ajmere-Merwara	61	Nil	21	Nil
Total	212,776	11,663 2 0	254,968	11,960 14 3

The deaths of human beings from snake-bite were, in 1880, 19,060; while in 1881 they were 18,610.

In 1880, 212,776 snakes were destroyed at a cost of Rs 11,663.

In 1881, 254,968 snakes were destroyed at a cost of Rs 11,961.

Thus with an increased expenditure of Rs 298 in 1881, 42,192 more snakes were destroyed and 450 lives were preserved, above the expenditure of the previous years.

With regard to the measures adopted for the destruction of venomous snakes, the following remarks are made by the Governor-General in Council :—

"As regards the destruction of venomous snakes, special measures were adopted in some provinces, of which it appears desirable to give a brief account in case they may be considered suitable for adoption elsewhere. In Bengal a scheme has been sanctioned by the local Government in the case of the Patna Division, under which persons destroying snakes can obtain certificates from certain selected planters vouching for the poisonous nature of the snakes destroyed. The production of such a certificate entitles the holder to secure from the local authorities the reward offered whenever he finds an opportunity of applying for it. As observed by the Government of Bengal, this concession will probably be found to add much to the convenience of persons claiming rewards, and to act as an inducement towards the destruction of poisonous snakes. The expediency of extending the scheme will be considered by the Local Government when the result of the current year's operations are known. In the North-Western Provinces and Oudh the Lieutenant-Governor and Chief Commissioner has sanctioned the entertainment tentatively in each district of those provinces of a staff of Kanjars, or men of similar caste, who trap and kill reptiles, for the systematic destruction of venomous snakes. These men will receive pay at the rate of Rs. 2 per mensem, together with an additional reward of two annas for every venomous snake in excess of twenty destroyed by each man during any month. A gang of snake-hunters is also to be employed at each tahsili, and, if the measure proves successful, it is proposed that similar gangs should be eventually appointed to each police circle of other local area. It appears to the Governor General in Council that a plan for the destruction of snakes such as that initiated in the North-Western Provinces and Oudh, is likely to prove far more efficacious than the mere offer of rewards, although it is true that unless such operations are confined to towns and villages and their neighbourhood, where it is believed that the largest number of deaths occur from snake-bite, they will probably be very costly. His Honour the Lieutenant-Governor of the Punjab has issued a circular to commissioners and superintendents in the Punjab, drawing attention to the matter with a view to the adoption of measures for destroying snakes by system of rewards to be granted by district committees and municipalities. Casts and lithographed pictures of the more common species of deadly snakes have already been supplied to the police stations in some districts, and deputy commissioners have been requested to suggest to municipal and

district committees the desirability of procuring similar means of reference for the purpose of testing applications for rewards. In British Burma the Chief Commissioner, with a view to encourage village snake-hunts in the rice plains, has arranged to grant sums varying from Rs 10 to Rs 20, according to the number of houses, in aid of a feast or *pweh* at the end of the annual hunt to every village which successfully carries out such an undertaking.

"On the whole, the results recorded during the year under review appear to the Government of India to be more satisfactory than those of the previous year. The Governor General in Council is glad to notice that the question of taking measures to reduce the lamentable loss of life which is at present caused by wild animals and venomous snakes is receiving the earnest consideration of Local Governments and Administrations, and His Excellency in Council will await with interest the reports showing the results of the special measures which have been adopted in some provinces. It is clear that much still remains to be done; but if sustained efforts are made and well-considered plans adopted for the extermination of wild beasts and deadly snakes, His Excellency in Council believes that the number of deaths from these causes will in course of time be materially reduced.—Simla, November 8, 1882."

From the above it appears that more vigorous measures than any hitherto adopted have been taken for the destruction of venomous snakes, and the contrast of the results of 1881 with those of 1880, warrant the anticipation of further benefit if these measures are only carried out with a sustained determination to succeed. It is mainly a question of perseverance and the expenditure of money, and one can hardly imagine a more desirable object on which to expend both energy and rupees. But it is essential that the system be laid down on some general principles for the whole of India, to be worked out in detail, according to the needs or peculiarities of each district. There should, in short, be a department with a responsible chief and subordinate agents, for whom certain rules should be laid down to be carried out steadily and without hindrance throughout the country, leaving much of the detail to the discretion of local authorities. I would insist on the importance of carrying it out on broad principles everywhere. When such a department is constituted under a proper head—and there are many persons well fitted for such a duty—then, I believe, venomous snakes and other noxious animals will decrease in numbers, and people will cease to be startled by these appalling losses of life. J. Fayrer

DESTRUCTION OF LIFE IN INDIA BY WILD ANIMALS

IN a recent communication I called attention to the loss of human and animal life in India from snake bites; I now proceed to describe the mortality due to wild animals, which, though much less than the former, is very considerable, and forms an important item in the mortuary returns.

The statement appended shows in detail for each province the number of persons and cattle killed by wild animals, and the number of wild animals destroyed, with the rewards paid for their destruction during the year 1881, as compared with the previous year. The figures are summarised in the following tables:—

Number of Human Beings and Cattle Killed by Wild Animals

	Persons killed.		Cattle killed.	
	1880.	1881.	1880.	1881.
Madras	223	238	8,667	8,668
Bombay	136	141	4,537	2,398
Bengal	1,295	1,367	14,567	8,423
North-Western Provinces and Oudh	561	470	8,140	7,971
Punjab	42	27	7,986	4,083
Central Provinces	289	248	3,711	2,929
British Burma	32	34	978	898
Coorg	Nil	Nil	219	191
Assam	234	211	3,269	2,802
Hyderabad Assigned Districts	24	18	3,560	3,013
Ajmere-Merwara	4	3	216	264
Total	2,840	2,757	55,850	41,640

Number of Wild Animals destroyed and Amount of Rewards Paid

	1880. Destroyed.	1880. Rewards. Rs.	a.	p.	1881. Destroyed.	1881. Rewards. Rs.	a.	p.
Madras	1,284	16,579	10	0	1,429	20,251	5	0
Bombay	1,717	4,775	1	0	1,367	4,965	13	0
Bengal	4,783	24,841	10	6	4,213	23,316	3	0
N.-W. Provinces and Oudh	2,924	7,295	4	0	3,037	8,434	14	0
Punjab	1,389	4,715	0	0	1,411	4,856	3	0
Cent. Provinces	1,408	17,887	8	0	1,351	15,842	0	0
British Burma	639	3,468	0	0	1,059	4,260	8	0
Coorg	26	140	0	0	15	215	0	0
Assam	541	7,022	10	0	1,176	7,552	2	0
Hyderabad Assigned districts	167	1,590	0	0	216	2,156	0	0
Ajmere-Merwara	8	13	0	0	5	Nil		
Total	14,886	88,327	11	6	15,279	91,850	0	0

The resolution of Government, dated November 8, 1882, in dealing with this subject, gives the following details, which are so far satisfactory, as they show that organised measures are now being put in force for the destruction of wild beasts, and that already there has been diminution in the loss of human and domestic

animal life. As in the case of venomous snakes, the prevention, or at all events diminution of loss of human and domestic animal life from the ravages of wild animals, is a question mainly of time, perseverance, and expenditure of money. The last consideration perhaps may have stood in the way of progress, not that expenditure of rupees either has been or would be grudged, were there certainty that it would overcome the evil, but that there may have been, perhaps is, a natural reluctance to spend public money for what seems an uncertain benefit, as some have regarded a system of rewards for destruction of snakes and wild animals. The Government of India has always evinced a desire to adopt any steps that might reasonably afford hope of relief, and many resolutions by the supreme and local Governments, and considerable expenditure of money wlth this object in view, proves that the authorities have been and are alive to the magnitude of the evil and to the importance of repressing it, and that they have taken measures which in some districts have been attended with a fair amount of success. But the absence of a thoroughly organised system of dealing with the evil, and the desultory and varying methods employed have prevented the attainment of the success that might fairly be expected and would be obtained under better arrangements; and it will not be until some complete organised system have been steadily and perseveringly prosecuted that the desired result will be accomplished. A few years ago (in 1878), when calling attention to this subject, I noted that the loss of life from wild animals in 1875 and 1876 had been as follows:—

Animals.	Killed in 1875.		Killed in 1876.	
	Persons.	Cattle.	Persons.	Cattle.
Elephants	61 ...	6 ...	52 ...	3
Tigers	828 ...	12,423 ...	917 ...	13,116
Leopards	187 ...	16,157 ...	156 ...	15,373
Bears	84 ...	522 ...	123 ...	410
Wolves	1,061 ...	9,407 ...	887 ...	12,448
Hyænas	68 ...	2,116 ...	49 ...	2,039
Other animals ...	1,446 ...	3,011 ...	143 ...	4,573
Total... ...	3,735 ...	43,642 ...	2,327 ...	47,962

Comparing these returns with that of 1880-81 it will be observed that the loss of life has not been materially diminished

	Persons killed.
1880	2,840
1881	2,757
1875	3,735
1876	2,327

though there is reason to hope that future yearly reports will be more favourable.

Registration is now becoming more accurate than it has been, and the returns are probably more reliable than they were, but they do not indicate any marked improvement on the whole. It is evident, however, from the terms of the resolution before referred to, that Lord Ripon is determined to deal vigorously with the evil, and, just as in the case of the poisonous snakes—only, perhaps, more surely —will the result, in time, justify the expenditure which must needs be incurred.

Of the wild animals and venomous snakes which destroy life in India, the wolf and tiger, it will be seen, are the chief offenders among the former, the cobra and bungarus (krait) among the latter. A list of the rewards that have been offered at various times and in different parts of India is appended, but I do not know the amount now offered for each animal, though it is probably much on the same scale. If these rewards be distributed regularly and systematically throughout India, they will probably suffice to insure a steady reduction in the number of noxious animals, and so will diminish a great evil.

"The figures quoted show a decrease during the year under review, as compared with the previous year, both in the number of persons and cattle killed; and, on the other hand, an increase in the number of wild animals destroyed. As was the case in the previous year, the mortality which occurred in Bengal and in the North-Western Provinces and Oudh, was far greater than in other provinces. Of the total number of deaths, 2757 were caused by wild animals, the figures for the previous year being 2840.

The number of persons killed in Bengal (747), and in the North-western Provinces, and Oudh (208) by wild animals other than those specifically named in the returns, was considerable. In future returns the animals which come under the general head "other animals," and which causes in all provinces a very large proportion of the mortality, should be specified in a foot-note, with the number of deaths caused by each kind.

The total number of cattle killed also decreased. This result is chiefly due to the exclusion from the Bengal return of sheep and goats, of which a large number were included in the figures of the year 1880. There has, however, been a marked decrease in the number of cattle killed by wild animals in the Bombay Presidency. In the Punjab, also, the number of cattle killed was considerably less than in the preceding year, but in this province, as in the case of Bengal, the decrease appears to be due to the exclusion of sheep and goats from the returns of the year 1881.

The number of wild animals destroyed was 15,279, against 14,886 in 1880. The number of tigers, leopards, bears, and wolves destroyed was 1557, 3397, 991, and 4538 respectively, as compared with 1689, 3047, 1100, and 4243 in the preceding year; and the number of human beings killed by these animals respectively, amounted to 889, 239, 75, and 256, against 872, 261, 108, and 347 in the year 1880.

Of the total amount of rewards paid during the year, Rs 91,850 were awarded for the destruction of wild animals.

In the review of the returns for the year 1880 a hope was expressed that endeavours would be made to induce men belonging to the Shikari class to devote themselves specially to the work of destruction in districts which are more than usually infested with wild animals, and Local Governments were authorised to make special arrangements for the experimental employment of such men.

From the present reports it appears that the Government of Madras has decided that the employment of a paid corps of Shikaris is undesirable, as the cost of supervision would be excessive, while the employment of such a corps would discourage local Shikaris. On this point the Governor-General in Council desires to remark that where local Shikaris exist it is very desirable that every encouragement should be held out to them, and that in such cases it is preferable to trust to fixed, certain, and prompt payments according to results, as the most effective way of inducing the Shikaris to devote themselves to the work. At the same time certain tracts of country exist in which the special and temporary employment of men from outside may be very useful and expedient, and the reports show that the adoption of this plan has in some cases been followed by satisfactory results. For instance, in the Futehpore district, in the North-Western Provinces, the entertainment of a body of special Shikaris resulted in the destruction of a considerable number of wolves with which that district was infested. In Dinapore, in the Lower Provinces, also, professional hunters were engaged during the closing month of the year for the destruction of tigers.

"In the Central Provinces the ravages committed by tigers in the Balaghat and Seoni districts necessitated the offer of enhanced rewards for their destruction, and the district officer of Seoni has endeavoured to organise a special expedition of shikaris for the purpose of hunting down the animals, and has provided the shikaris with ammunition. Licenses under the Arms Act appear to have been more freely given than hitherto to persons who require arms for protecting themselves and their cattle and crops from the attack of wild animals, but the Governor-General in Council desires to take the opportunity of expressing a hope that this matter will be carefully kept in view by Local Governments and Administrations in order that every possible facility may be offered to cultivators and others for obtaining such licences in districts in which wild beasts are more than usually abundant."

Wild Animals destructive to Life in India

CARNIVORA

Felidæ

Felis—F. leo	Lion
F. tigris	Tiger
F. pardus	Leopard
F. jubata	Hunting Leopard

Hyæninæ

Hyæna—H. striata	Striped Hyæna

Canidæ

Canis—C. pallipes	Wolf
C. aureus	Jackal

Ursidæ

Ursus—U. isabellinus	Brown Bear
U. tibetanus	Black Bear
U. labiatus	Sloth Bear.

UNGULATA

Elephantidæ

Elephas—E. indicus	Elephant
Rhinoceros—R. indicus	Rhinoceros

Suidæ

Sus—S. indicus	Wild Boar

Bovinæ

Gavæus—G. gauri	Bison, gaur
Bubalus—B. arni	Buffalo, arna

SAURIA

Crocodilidæ

Crocodilus—C. palustris	Crocodile
C. biporcatus	,,
C. pondicerianus	,,
Gavialis—G. gangeticus	Gharial

PISCES

Carcharidæ

Carcharias—C. gangeticus	Groundshark of Ganges

Poisonous Snakes of India

Those marked with an * are most deadly.
Those marked with a † are most common among the most deadly.

POISONOUS COLUBRINE SNAKES

Elapidæ

1. Naja	N. tripudians †, cobra, several varieties
2. Ophiophagus	O. elaps *, hamadryas
3. Bungarus	B. cæruleus †, krait
,,	B. fasciatus, sankni
4. Xenurelaps	X. bungaroides
5. Callophis	C. intestinalis and several other species

Hydrophidæ, or Sea Snakes (all deadly)

1. Platurus	P. scutatus, P. Fischeri
2. Hydrophis	H. cyanocincta, and several other species
3. Enhydrina	E. bengalensis
4. Pelamis	P. bicolor

VIPERINE SNAKES

Crotalidæ, or Pit Vipers

1. Trimeresurus	T. gramineus and several other species
2. Peltopelor	P. macrolepis
3. Halys	H. himalayanus
4. Hypnale	H. nepa

Viperidæ, or true Vipers

1. Daboia	D. russellii †, Chain Viper, Tic-polonga
2. Echi	E. carinata †, Phoorsa snake, Afaë, Kuppur

The following is a scale of the rewards offered in different parts of India, at different times, for wild beasts and snakes :—

Tigers

	Rupees.
Bengal	$12\frac{1}{2}$ to 50
Berar	10 ,, 20
Bombay	6 ,, 60
Burmah	5 ,, 20
Central Provinces	10 ,, 100
Hyderabad	20
Madras	50 to 500
Mysore	35
North-West Provinces	10
Oudh	None
Punjab	None
Rajpootana	10 to 15

Lions

The only record of which I find official mention, is 25 rupees in Kotah.

Panthers, Leopards, Cheetahs

	Rupees.
Bengal	$2\frac{1}{2}$ to 10
Bombay	3 ,, 12
Burmah	5 ,, 10
Hyderabad	10
Madras	25
Mysore	15
North-West Provinces	5
Rajpootana	8 to 10
Central Provinces	5 ,, 12

Wolves

	Rupees
Bengal	5 to 20
Berar	3 ,, 5
Bombay	4
Central Provinces	2 to 5
Madras	5
North-West Provinces	5
Oudh	1 to 6
Rajpootana...	5

Hyænas

	Rupees.
Bengal	1 to 2
Berar	5
Central Provinces	$\frac{1}{2}$ to 2
Madras	$3\frac{1}{4}$

Bears

	Rupees.
Bengal	$1\frac{1}{4}$ to $2\frac{1}{2}$
Berar	5
Bombay	3 to 12
Burmah	5 ,, 12
Hyderabad	5
Madras	5
Central Provinces	2 to 5
North-West Provinces	3
Rajpootana...	5

Snakes (Species not reported)

Bengal	4 annas
Berar	—
Bombay...	6 pie to 4 annas
Burmah	—
Central Provinces	1 rupee

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Hyderabad	8 annas to 2 rupees
Madras	1 anna
Mysore	8 annas
North-West Provinces... ...	2 rupees
Oudh	—
Punjab	2 annas
Rajpootana	1 to 8 annas

No rewards appear officially proclaimed for elephants, buffaloes, or bisons. In cases of notorious rogue elephants rewards have been specially given. In Burmah 5 to 20 rupees offered for alligators ; in special cases, more has been given in Bengal and Madras.

The difference in the amount of the rewards appears to indicate that higher sums were offered in special cases, probably when the creature was a notorious man or cattle-slayer.

Now I cannot help thinking that if Government made it part of the duty of district officers, not only to proclaim these rewards but to encourage the destruction of wild animals and snakes, by means of an organised establishment, which should be supplied in these districts, much benefit might result. The money rewards already offered would probably suffice for wild animals, but those for venomous snakes should be increased ; if, at the same time, the people were encouraged to work for the rewards, and were aided by persons acting under properly selected superiors, the result would soon show a diminution of the wild animals and snakes. But, I repeat that not until some organised establishment is formed, to be worked steadily throughout the whole country—not dependent on the will or subject to the caprice of individuals, but under local officers subject to one head—will any real or progressive amelioration of the evil be effected. Such a department under a selected officer, would, as was the case with the Thugs and Dacoits, soon make an impression on a death-rate which, so long as it continues in its present condition, must be referred to a defect in our administration.

J. FAYRER

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Read before the Medical Society of London. January 25th 1884.

On the Nature of Snake-Poison.

THE communication which I have the honour of making to you this evening is in fulfilment of a promise made last April, after the discussion of a paper on a similar subject by Dr. Badaloni of Nocera, which excited considerable interest and some criticism with regard to the purely scientific aspect of snake-poisoning, its treatment, and its relation to the vital statistics of countries in which venomous snakes are more numerous than in our own (in this respect) more highly favoured one.

I purpose to describe the nature and the mode of action of snake-poison on living creatures; and, being most familiar with the Ophidia of India, I shall select some illustrations from that source, especially as it affords typical examples of snakes which are endowed with this terrible power of destroying life.

Let me ask your attention to some points in the structure of the apparatus which is concerned with the elaboration and inoculation of the poison which it is the purpose of this paper to describe.

The order Ophidia has three subdivisions:

1. Ophidii Colubriformes (innocent).
2. Ophidii Colubriformes Venenosi.
3. Ophidii Viperiformes.

The two latter are all poisonous—they are the Thanatophidia, and well merit this name in India, where they destroy, probably, 20,000 human beings annually.

The general anatomical structure and distinctive characters of a snake are well known, but I will ask you to notice certain differences between:

1. An innocuous and a poisonous snake.
2. Between a poisonous colubrine and a viperine snake.

The crania drawings and dissections before you illustrate these differences. Snakes are provided with sharp re-curved teeth, which are firmly fixed in the maxillary palatine, and pterygoid bones; by the form and arrangement of these teeth, poisonous may be distinguished from innocent snakes.

The harmless snake has two complete rows of ungrooved

small teeth, one outer or maxillary, and one inner or palatine row; in the majority, there are from 20 to 25 teeth in the outer row.

In the venomous snakes, the outer row is represented by one or more large tubular fangs, firmly anchylosed to the maxillary bone, which is movable, and by its movement causes the erection or reclination of the fang which is so marked in viperidæ. In the innocent snake, the maxillary bone is elongated, and gives insertion to a row of teeth; in the poisonous colubrine, it is much shorter, giving insertion to only one or more teeth, the anterior and largest of which is the poison-fang.

In the viperine snakes, the maxillary bone is reduced to a mere wedge, giving insertion to a long curved and tubular fang, which is a much more formidable weapon than the fang of the cobra, or other colubrine snake.

These fangs, when reclined, are covered by a sheath of mucous membrane, in which lie also several loose reserve fangs, in different stages of growth. When the working fang is lost by accident, or is shed, one of the reserve fangs takes its place, becoming fixed to the maxillary bone, and placed in communication with the duct of the poison-gland.

The teeth vary considerably in the different subdivisions of the order. They are described as being perforated. Though this is apparently the case, it is not really so. They are dense and compact, enclosing the usual pulp-cavity; but being folded on themselves form either an open groove, as in the hydrophidæ; a complete canal, as in cobra; or a more complete tube still, as in viperidæ.

During development, the laminated tooth folds like a leaf on itself, and so forms the channel along which the virus is conveyed; and thus the tooth makes a most complete hypodermic syringe.

The poison is secreted by a conglobate racemose gland situated in the temporal region behind the eye. It is of considerable size—about that of an almond in the cobra—and is furnished with a duct which opens into the capsule of mucous membrane enveloping the base of the fang; the venom thence flows into the dental canal, and is injected into the wound when the tooth penetrates the bitten object. At the orifice of the duct it seems probable that there may be a sphincteral arrangement of muscular fibres which would enable the snake to control the ejaculation of the virus.

I have not been able to make out such a sphincter in the elapidæ; but Dr. Weir Mitchell says it exists in crotalus. I may have overlooked it, and think it probable that further examination may detect it in other poisonous snakes. I may here just refer to the remarkable mechanism by which, the ectopterygoid bone being pushed forwards, the maxillary is made to rotate, and to erect the fang in the viperine snakes; and to the action of the temporal and masseter muscles, which, whilst they close the jaw in the act of biting, at the same time compress the gland, and force the poison through the duct. Time does not admit of anatomical details; but they are fully described in the *Thanatophidia* (pp. 1 to 5), and are represented in the sketches and specimens before you.

Before I pass on to consider the poison, let me say a few words about the poisonous snakes themselves. Here I may remind you that the only poisonous snake in Great Britain, and, indeed, in a great part of Europe, is the adder—*Pelias berus*—a viper (or some variety of it); and that, in comparison with the cobras and vipers of India and the Tropics, it is feeble in its venomous power.

The venomous colubrine snakes of India are: of elapidæ, the naja tripudians or cobra, ophiophagus elaps or hamadryad, bungarus ceruleus or krait, bungarus fasciatus or raj-samp, sankni; of xenurelaps, x. bungaroides, and the various species of callophis; hydrophidæ a very numerous family of sea-snakes all are very poisonous, but, being confined entirely to a marine or estuarial life, are not so dangerous to human life as others.

The viperine snakes are represented by daboia russelii (or tic polonga, or chain-viper); echis carinata (or kupur, or phoorsa-snake); these are true vipers; whilst the crotalidæ, or pit-vipers, are only feebly represented by the trimeresuri, peltopelor, halys, and hypnale; these are much less poisonous than their American congeners, crotalus, lachesis, cruspedocephalus, and others.

The najadæ are the most virulent of the colubrine snakes; none are more deadly than the cobra or hamadryad. Of viperidæ the daboia and echis are probably as deadly as any of the African forms.*

In 1868, I resumed an investigation, begun in 1854, on

* Of American elapidæ, elaps corallinus, and lemniscatus. Of American crotalidæ, crotalus, (rattle-snake), lachesis-mutus; craspedocephalus (West Indian). Of African elapidæ, naja-haje, naja-hæmachates: of viperidæ, cerastes, and four or five others are very dangerous.

the subject of poisonous snakes and the nature and effects of their venom. During that inquiry, which continued till 1871, I ascertained from official sources that out of a population of 120,972,263 (Dr. Hunter), 11,416 persons died of snake-bite in the year 1869. Subsequent returns show that the mortality continues at very much the same rate. The Sanitary Commissioner, in his report on the North-West Provinces and Oude for 1882, tells us that 6,515 persons were killed in that year by snakes and wild beasts, out of a population of 44,107,869. In 1881, in all India, there were 22,377 deaths from the same cause.

In destructiveness the snakes stand in about the following order: cobra, krait, echis, daboia.

The ophiophagus elaps, bungarus fasciatus, and hydrophidæ are deadly but less numerous, and therefore less destructive to life.

The returns cited represent only a portion of India, and there is good reason to believe that the total annual mortality of the whole peninsula is not much, if at all, under 20,000 persons, or roughly about one in every 10,000.

The subject is of much general interest, and it is as important to humanity as to science to ascertain the nature and properties of the poison, and to discover what may best counteract it.

Snake-poison is secreted by glands which represent the parotids in other creatures (a small gland is connected with the duct of the poison-gland in daboia, and was figured in a drawing by me, made in 1869. Dr. Wall suggests that its secretion may in some way modify the action of the poison, perhaps giving it the peculiarity in which it differs from the cobra-venom) and is probably a modification of the saliva, though different in its action from that innocent and indispensable secretion. The analogy is more probable if, as suggested by some physiologists, Mr. Busk and others, there be an active principle in it, closely allied to the ptyaline of saliva.

The virus is a transparent, slightly viscid fluid, faintly acid in reaction, of varying specific gravity, 1·058 being the average (according to Wall) of a mixture of virus taken from several cobras. It has a bitter taste in the cobra, but not bitter in daboia. It is of a faintly straw-coloured hue in cobra; in the ophiophagus of a golden yellow. When dried it loses from 50 to 75 per cent. of water (Wall) and forms a semi-crystalline substance like gum-arabic. It is secreted in considerable quantities, and if a fresh and

vigorous cobra be made to bite through a leaf stretched across a spoon or shell, several drops can be thus obtained. Examined under the microscope it is structureless, but a few cell-forms and micrococci may be detected. The mucus of the mouth may be the origin of these organisms, and it is probable that there is nothing characteristic in them (Wall), for the most active venom is free from them. The poison is exhausted when the snake has bitten frequently, and it is then comparatively harmless; but it rapidly becomes dangerous again.

"If the virus be kept in the liquid state it first becomes neutral, then alkaline, and a few feathery cubic crystals form; if preserved in a loosely corked test-tube, it will become cloudy, smell offensively, and swarm with bacteria, but still it is poisonous.

"The alkalinity now lessens, and the reaction becomes again acid; the fluid then coagulates into a firm whitish opaque substance, somewhat like the coagulated white of an egg, but of a lemon colour.

"If a small quantity of fluid be left uncoagulated it is poisonous, and the washings of the coagulum are also poisonous." (Wall)

Heating cobra-poison to boiling point (Wall says) does not destroy its physiological action, though less local inflammation is caused by it so treated.

Snake-poison has been examined by chemists, but a complete or exhaustive analysis has not yet been given.

Fontana, in 1781, and Prince L. Bonaparte, in 1843, made an analysis of the virus of the adder *(Pelias berus)*, and came to the conclusion that it contained an active principle, to which he gave the name of echidine or viperine, which he succeeded in separating. The paper in which he describes the process was read before the Union degli Scienziate Italiani at Lucca in 1843, and is in our library; so far as I know but little has been added since Prince Louis Bonaparte's investigations; further analysis will probably confirm or modify his views, and perhaps add to our information. The Prince laboured under the disadvantage of having only adder-poison to analyse. With a better supply of cobra, daboia, or crotalus virus, which might now be obtained, there are good grounds for hoping that the chemistry of snake-poison will be exhaustively worked out. This is now being done in America by Drs. Weir Mitchell and J. E. Reichardt, who have published some results of their work.

In 1873, cobra-poison from Bengal was submitted to Dr. Armstrong, F.R.S., for analysis, and he obtained the following results :—

Crude Poison.	Alcohol Precip.	Alcohol Extract.	Albumen for Comparison.	
				(Ralfe)
Carbon, 43.56	45.76	43.04	53.5	53.5
Nitrogen, 40.30	14.30	12.45	15.7	15.5
Hydrogen.......................	6.60	7.0	7.1	7.0
Sulphur..........................	2.5	...	...	1.6
Oxygen..........................	...	...	...	22.0
Phosphorous	...	...	...	0.4

This is an incomplete analysis, but it is to be hoped that the same eminent chemist may be disposed to continue the investigation when supplied with more virus.

The following is an epitome of Weir Mitchell and Reichardt's investigations, which relate chiefly to crotaline poison, but include a partial analysis of some dried (colubrine) poison from India. They find that the venom of the crotaline snakes can be subjected to the action of the temperature of boiling water, without completely losing its poisonous powers. The activity of the venom, however, of *crotalus adamanteus* seems to be destroyed by a temperature below 176 deg. Fahr. Mitchell, some years ago, showed that the venom of *crotalus durissus* is not destroyed by boiling, and the curious fact is noted that the venom of *crotalus adamanteus* should thus differ from the venom of other snakes.

The symptoms caused by the venom of the different snakes with which they have operated do not, they say, differ radically, save in degree, but there are symptoms which suggest that further investigation may enable them to point out certain differences by which it will be possible to discriminate one form of poisoning from the other. This is partly in accordance with what has already been observed in India, and notably by Dr. Wall.

The investigations, so far, lead them to conclude that the poison of the cobra is the most active, next the copperhead, then the mocassin, and lastly, the rattle-snake; but their researches on this head are not yet complete.

They are unable to confirm the statement of Gautier of Paris, that an alkaloid, resembling a ptomaine, exists in cobra poison. Professor Wolcott Gibbs, they say, was unable to find an alkaloid in the poison of crotalus, but they have satisfied themselves that the venom contains

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three distinct proteid bodies, two of which are soluble in distilled water, one which is not soluble. These bodies have certain properties and reactions, which are detailed in their monograph on the subject.

Hitherto, observers have regarded the venom of different snakes as each representing a single poison; but it appears that, of the three proteids before mentioned, one is analogus to peptones, and is a putrefacient poison; another is allied to globulin, and is a most fatal poison, probably attacking the respiratory centres, and destroying the power of blood to clot, while the third resembles albumen, and is probably inocuous. The separation of the poisons necessitates a long and elaborate series of researches, the results of which will be subsequently reported. They have also ascertained that the poison of the rattle-snake (*crotalus adamanteus*), copper-head (*Trigonocephalus contortrix*), and mocassin (*Toxicophis piscivorus*), are destroyed by bromine, iodine, hydrobromic acid (33 per cent.), sodium hydrate, and potassium permanganate.

It appears that the activity of the venom differs not only in character and intensity in different genera and species, but also in the same individual under varying conditions of temperature, climate, health, and state of vigour or exhaustion at the time. It is a most virulent poison, and it takes effect when absorbed into the circulation, either by inoculation, or as I demonstrated in India (quite against all former and universal belief) when applied to a mucous or serous membrane, proving that it may neither be sucked from a bite, nor swallowed with impunity.

It acts most rapidly on warm-blooded creatures, sometimes with lightning-like rapidity, when it enters a vein; it is deadly also to cold-blooded creatures, and to the lowest forms of invertebrate life. Strange to say, and this, to me, is one of the greatest of its mysteries, a snake cannot poison itself, or one of its own species, scarcely its own congeners, and only slightly any other genus of venomous snake, but it kills innocent snakes quickly. It has been ascertained that a vigorous cobra can kill several dogs, or from a dozen to twenty fowls before its bite becomes impotent, and then the immunity is of brief duration, for the virus is rapidly reformed.

In 1868 and 1869 I observed that, whilst the general characters of the effects of snake-poison are alike, yet viperine differs from colubrine poison. The poison of naja kills without destroying coagulability of the blood, whilst that

of the daboia (viper) produces complete permanent fluidity (*Thanatophidia*, p. 4), and, in connection with this, "the blood of an animal killed by snake-poison is itself poisonous, and, if injected into an animal, rapidly produces its poisonous effects. I have transmitted the venom through a series of three animals with fatal results."

In 1868 I described the difference of the action of cobra and daboia-venom in the case of two horses bitten by these snakes (*Thanatophidia*, p. 79). At pp. 72-73, *op. cit.*, I also pointed out the peculiar action of daboia-venom in causing early convulsions. In some the convulsions are more marked, and, in others, death is preceded by a more decided state of lethargy. In the bite of the echis the local symptoms are peculiarly severe, so (*Thanatophidia*, p. 631) Dr. Wall gives a more complete exposition of the varying effects, and shows them to be greater than I supposed.

Snake-poison is a narcotic, and kills by extinguishing in some way (some molecular change) the source of nerve-energy. It is also a blood-poison and an irritant, if applied to mucous and serous surfaces it causes inflammation; absorption then takes place, and the symptoms of general poisoning are induced. It causes great local disturbance as well as blood-change; for, if the bitten creature survive long enough, the areolar tissue may inflame, suppurate, and slough. If it enter by a large vein, life may be destroyed in a few seconds. It was supposed the more active poisons acted by shock through the nervous system, but the rapidity with which a poison can be distributed through the circulation would account for the most rapid death from snake-bite. The chief effect is on the respiratory apparatus, and death occurs by asphyxia; but the whole voluntary muscular system is also affected, and general paralysis results; whilst the long continuation of cardiac pulsation after apparent death, proves that it is not due to failure of circulation.

The action of snake-poison is discussed at full length in the *Proceedings of the Royal Society* by Dr. T. L. Brunton and myself (1873-74-75-78). These researches led us to conclude that the action of the poison is: (1) on the cerebral and spinal centres, especially the medulla, inducing general paralysis, especially of respiration; (2) in some cases, where the poison has been conveyed through a large vein directly to the heart by tetanic arrest of cardiac action, probably owing to action in the cardiac ganglia; (3) by a

combination of these causes ; (4) by blood-poisoning of a secondary character.

The phenomena vary according to the nature of the snake, and the individual peculiarities of the creature injured, the chief difference being observed in viperine as contrasted with colubrine poison. The latter is a nerve-poison of great deadliness ; but as a blood-poison it is not of much power. Viperine poison, on the other hand, is a more potent blood-poison. Dr. Wall summarises the difference in the action of daboia (viperine) or cobra (colubrine) poison as follows : " Cobra-poison, when introduced slowly into the circulation, produces gradual general paralysis, but, at the same time, shows a preference for certain nerve-centres ; paralysis of the tongue, lips, and larynx being very marked symptoms, and respiration is very quickly extinguished after the paralysis shows itself. Death is often attended with convulsions, which are clearly due to carbonic acid poisoning. Introduced with a fair amount of rapidity, these symptoms are rapidly developed, the paralysis being preceded by gentle stimulation, which causes slight muscular twitchings. Injected in a large quantity into the circulation, the stimulation is so violent as to cause general convulsions, of which, however, the respiratory muscles have the chief share, and which are immediately followed by paralysis and death.

" Daboia-poison, though not injected directly into the circulation, causes the most violent convulsions, which are in no way necessarily followed by paralysis and death, but may be, for the time, completely recovered from. They do not depend on carbonic acid poisoning. The paralysis that succeeds is general, and lasts a very considerable time before respiration is extinguished. There is no evidence of the tongue, lips, and larynx being especially paralysed ; they probably only suffer in the same degree as other parts. Cobra-poison very quickly destroys the respiratory functions—after slight acceleration the respiration becomes slower, and the excursus is lessened. Daboia-poison at first quickens the respiration very much more than cobra-poison does, and the lessening of the excursus and the slowing of the breathing does not occur so soon. The respiration generally in daboia-poisoning has a peculiarly irregular character. This function certainly exists longer under the influence of daboia-poison than under that of cobra-poison. The effect of cobra-poison on the pupil is so slight as to be a matter of doubt. Daboia-poison

nearly always causes wide dilatation in the earlier stages of the poisoning. Salivation is a constant symptom of cobra-poisoning ; it is exceedingly rare in daboia-poisoning.

"The effect of cobra-poison in the blood is not very great, Sanious discharges are rare, albuminuria has not been seen, and recovery is striking and complete when it takes place. In daboia-poisoning, on the other hand, sanious discharges are the rule. Albuminuria is usual should the victim live any time; and, after the nerve symptoms have passed away, the subject has to go through a period of blood-poisoning little, if at all, less dangerous than the primary symptoms ; we have, in addition, the greater local mischief caused by daboia-poisoning, and the greater power it has of destroying the coagulation of the blood.

"The physiological properties of daboia-poison undergo great change by its being heated to 100C. in solution, losing the power of producing primary convulsions, whereas cobra-poison remains unaltered. Daboia-poison kills birds at once in convulsions, whereas, with cobra-poison, unless the poison has been directly injected into the circulation, death occurs only after paralysis.

"Lastly, amphibia recover from an amount of daiboia-poison that would be necessarily fatal in the case of cobra-poison."

Without unreservedly accepting Dr. Wall's conclusions, I regard them as an able summary of the action of different kinds of snake-poisons, and they confirm the deadly nature of Indian as compared with European snake-poison.

The local effects of the poison are partial paralysis of the bitten part, pain, infiltration, swelling, inflammation, and ecchymosis round the spot where the poison has been introduced, and sometimes in other and distant parts, and, if the animal survive for some hours, infiltration and incipient decomposition of the tissues and hæmorrhagic discharges. The general symptoms are depression, faintness, cold sweats, nausea, vomiting, exhaustion, lethargy, unconsciousness.

Dogs vomit, and are profusely salivated. They present an appearance as if the hair were "staring." As the poisoning proceeds, paralysis appears in the limbs, commencing generally in the hinder parts, with a tendency to creep over the whole body, involving the muscles of deglutition, and loss of co-ordinating power of muscles of locomotion. Albuminuria (especially in viperine poisoning), hæmorrhagic dis-

charges, relaxation of sphincters; exhaustion, lethargy, and convulsions precede death.

In fowls the appearance is that of great drowsiness. The head falls forwards, rests on the point of the beak, and gradually the fowl, no longer able to support itself, rolls over on its side. There are frequent startings, as if of sudden awaking from the drowsy state, then convulsions and death.

In cases where the quantity of poison injected is large, and it is at the same time very active (as in cobra), the bitten animal small and weak, or if it have entered a vein death is almost instantaneous, as from shock. In such case, the cardiac ganglia are probably paralysed; at all events, the heart suddenly ceases to beat.

The effects of snake-poison on man are much of the same character, and may be studied in the details of sixty-five cases recorded in the *Thanatophidia*, which also give an idea of the duration of life. Dr. Wall has summarised them as follows: "The average length of time of the sixty-five cases is 15·17 hours; but the average is raised by the exceptionally long duration of a few cases of viperine poisoning, so that a better estimate of the probable duration of time will be obtained by dividing the period in spaces of one hour each, and determining what percentage of deaths occur in each.

	Per centage.		Per centage.
One hour and under ...	10.76	Between 7 and 8 hours...	4.61
Between 1 & 2 hours ...	12.3	„ 8 „ 9 „ ...	3.07
„ 2 „ 3 „ ...	13.84	„ 9 „ 10 „ ...	7.69
„ 3 „ 4 „ ...	7.61	„ 10 „ 12 „ ...	4.61
„ 4 „ 5 „ ...	1.54	„ 12 „ 24 „ ...	9.36
„ 5 „ 6 „ ...	1.54	Over 24 hours	20.00
„ 6 „ 7 „ ...	3.07		

"The most fatal periods appear to be between two and three hours, and more than twenty-five per cent. of the total deaths take place between one and three hours after the infliction of the bite."

It appears, also, from the above report in which, in fifty-four cases the exact spot is described, that 94·54 per cent. are wounded in the extremities.

Place of Bite.	Per centage of Cases.	Place of Bite.	Per centage of Cases.
Fingers and wrist ...	31.48	Leg	3.70
Fore arm	1.85	Thigh	1.85
Elbow	5.56	Breast	1.85
Shoulder	1.85	Ear	1.85
Feet, toes, ankle ...	48.15	Perinæum	1.85

This is a matter of some interest, as the hope of success lies in preventing access to the circulation, and in the facility of removing the part injured, and with it the inoculated venom.

The greater proportion of deaths recorded, result from the direct effects of the poison; chronic cases, in which death or recovery resulted after protracted periods, are less frequently referred to.

Snake-poisoning in this country is of the viperine character, and though happily the activity of our viper is feeble compared with that of the tropical viperidæ, and except in the case of very weak or young creatures, its immediate effects as a nerve poison are feeble; yet the effects on the blood, and, locally, on the tissues, may be productive of severe and even dangerous symptoms.

The result of my experience is that, so far, no physiological antidote to snake-virus is known, and that when the full effect on the respiratory centres is produced, remedies are of little, if any, avail; albeit, when the poison has entered in smaller quantities, treatment may be of service on general principles.

Viewing the apparent analogy between curare and snake-poisoning, death in both being caused by paralysis of the respiratory apparatus, Dr. L. Brunton and I hoped that, by keeping up artificial respiration, and supporting the body-temperature, we might keep an animal poisoned by snake-virus alive until elimination had taken place; and the result of some experiments justified the anticipation to some extent, for animals were kept alive for many hours, but succumbed at length when the artificial respiration was withdrawn. Mr. V. Richards, who repeated our experiments in India, succeeded in thus keeping an animal alive for days, though it, too, succumbed finally. In the case of curare, artificial respiration is completely successful, though not so in snake-poisoning. This seems to show that the damage done by the snake-poison is of a more serious and permanent nature than that by curare, as indeed I am inclined to believe, though I do not say that a physiological antidote is impossible; all I assert is, that it has not yet been found. I would encourage efforts to devise a method of treating snake-poisoning in whatever degree it presents itself, for some means of neutralising the poison, or of restoring the damaged nervous system and blood, may still be found; at any rate, it is with snake-virus as with other deadly poisons: there must be a quantity, however

small, which, though dangerous, is not of necessity fatal, in such cases we may influence the result by treatment, and save life in some. But after long and repeated observation in India, and subsequently in England, I am forced to the conclusion that all the remedies hitherto regarded as antidotes are absolutely without any specific effect on the condition produced by the poison, and that such aid as we can give must depend on preventive and local treatment.

I will now briefly describe the measures to be adopted in the treatment of snake-poisoning, and especially refer to the permanganate of potash as a remedy, and shall read a letter from Dr. M. de Laçerda, of Rio de Janiero, written by that distinguished physician as a commentary on the discussion which took place here last April on Dr. Badaloni's paper.

The first and most important indication is to prevent the poison entering into the circulation; to this all else is subsidiary. The rapidity with which this takes place depends a good deal on the part of the body bitten, and on its vascularity. When the poison enters a vein, if the bite be inflicted by a vigorous snake, the result is generally rapidly fatal. Experiments on animals show that bites inflicted on parts, even where large veins are not implicated may produce their effects so rapidly, that only immediate severance of the part, or complete constriction, prevents absorption.

It is necessary, therefore, as quickly as possible after a bite has been inflicted, to apply a ligature above it, and so tighten it as to completely arrest the circulation. As it happens in 94 per cent. of cases that the bite is inflicted on an extremity, this may frequently be accomplished; but, in parts where no ligature or elastic bandage or cord can be applied, proceed at once to excise the bitten part; this, indeed, should be done in all cases, ligatured or not; then make an incision through the bite, and reflect the skin; expose the tissue wherever that is altered in colour, dissect it out, and be careful to remove every part of it; then apply cautery, some escharotic, or the permanganate solution, taking care that it reaches, as much as possible, in every direction where the poison may have infiltrated. After this is done, the ligature may be relaxed; for, if the virus be destroyed, the danger of its entering the circulation is past. Should it have already entered, as is only too probable, all that can be done is to give stimulants, keep the patient warm, at rest, and, when the respiration begins

to fail, use artificial respiration, and endeavour to keep the patient alive till the poison be eliminated.

In 1869 I gave instructions for the treatment of snake-bite, and, excepting that I would substitute Esmarch's bandage for the ligature, as recommended by Dr. Wall;—that permanganate, five per cent. solution, should be applied to the wound when the venom has been carefully dissected out, or injected when it has not been cut out, I have nothing to alter in these suggestions.

Suction, being unlikely to be of much avail, is practically useless to the patient and dangerous to the operator, and should neither be encouraged nor relied on. Insist on the importance of quiet and perfect rest; the temperature should be kept up; the respiration, if it begin to fail, supported by artificial methods. Where the poison has happily been limited to the seat of inoculation, and in cases where no great quantity of virus has been absorbed, we may hope to do good; but where the poison has entered the circulation in larger quantities, and the physiological symptoms are developed, the prognosis is exceedingly unsatisfactory.

As soon as possible after a person is bitten by a snake, apply a ligature made of a piece of cord, or elastic bandage, round the limb or part, at about two or three inches above the bite. Introduce a piece of stick or other lever between the cord and the part, and, by twisting, tighten the ligature to the utmost. After the ligature has been applied, cut the punctures, to the depth of a quarter of an inch, with a penknife, or other similar cutting instrument; let the wounds bleed freely; or, better still, excise the punctured part and all the infiltrated areolar tissue subjacent to it. Apply either a hot iron or a live coal to the bottom of these wounds as quickly as possible, or inject into the subcutaneous cellular tissue a solution of permanganate of potash, five per cent., or some carbolic or nitric acid. If the bite be where a ligature cannot be applied, with a sharp penknife, cut out the bitten part and all the infiltrated cellular tissue to the depth of a quarter or half of an inch; then apply a hot coal or hot iron to the very bottom of the wound, or, better, the permanganate of potash. Give fifteen drops of liquor ammoniæ diluted with an ounce of water immediately, and repeat it every quarter of an hour for three or four doses, or longer if symptoms of poisoning appear; or give hot brandy, or rum, or whisky, or spirits with equal parts of water, about an ounce of each (for an adult), at the same intervals. Suction of the wounds is not very

likely to be beneficial, and as it may be dangerous to the operator, it cannot be recommended.

If symptoms of poisoning set in and increase, if the patient become faint or depressed, unconscious, nauseated, or sick, and respiration begin to fail, with symptoms of paralysis of tongue and fauces, apply mustard poultices, or liq. ammoniæ on a cloth, on the stomach and heart; continue the stimulants, and keep the patient warm; but do not shut him up in a hot stifling room, or a small native hut; rather leave him in the fresh air than do this.

Chronic, *i.e.*, milder cases, must be treated on the same and general principles. Do not make the patient walk about; if depressed, rouse him with stimulants, mustard poultices, or ammonia, but let him rest.

If the person be brought, as he or she probably will be, some time after the bite has been inflicted, and symptoms of poisoning are present, the same measures are to be resorted to. They are less likely to be successful, but nothing else can be done.

In many cases the prostration is due to fear; the bite may have been that of a harmless or exhausted snake, and such will rapidly recover if so treated and encouraged. If poisoned, but, as frequently is the case, not fatally, these measures are still the most expedient.

A plain summary or translation of these suggestions might be hung up in public places. The people should be warned against incantations, popular antidotes, and delay in seeking for aid. Every police inspector, of whatever grade, might be taught the application of the simple measures I have described, and should be enjoined to make them known as widely as possible among the police and the people.

There can be little doubt that recoveries from Indian snake-poisoning occur chiefly in cases where the snake has been exhausted or harmless, or has bitten imperfectly, and in a few cases where prompt interference has prevented the entry of the poison into the circulation.

Let me now make some remarks on the remedial value of permanganate of potash. During my investigation of the value of remedies for snake-poisoning, permanganate of potash was not omitted, and I made the following experiments:—

June 12th, 1869.—First, a fowl was bitten by a cobra in the thigh at 3 p.m.; at 3.1 fifteen drops of liq. potass. permanganate were injected into the spot; dead in seven

minutes, 3.35. Second, forty drops of liq. pot. permanganate injected into the external jugular of a dog. This produced no apparent effect on the animal. At 3.48, bitten by a cobra (which had bitten before and was not fresh) in the thigh; the fang punctures were at once washed with the strong solution of permanganate, which was well rubbed in; 3.52, sixty more drops injected into the vein; 3.54, two drachms injected into the bowel, all the symptoms of cobra-poisoning advancing rapidly; 4.12, forty more drops injected into jugular vein; 4,25, dead in thirty-seven minutes.

In 1878 Dr. Brunton and I made the following experiments, which confirm the power of the permanganate to neutralise the poison before it has entered the circulation, but show its inefficiency when it follows it.

Experiment 1.—Five milligrammes of poison were dissolved in one cubic centimètre of water, and mixed with one cubic centimètre of liquor potassæ permanganatis, and injected under the skin of a guinea-pig. No symptoms were produced, and the animal remained quite unaffected.

Experiment 2.—Two rabbits of the same litter, each weighing exactly 2 lbs., were taken. Five centigrammes of cobra-poison, dissolved in one cubic centimètre of liquor potassæ permanganatis, and allowed to stand for about eight minutes. The mixture was then injected under the skin of the flank of one rabbit. No symptoms whatever were produced, and the animal though kept under observation for some weeks, remained quite unaffected by the poison. Five milligrammes of cobra-poison, dissolved in two cubic centimètres of water, were injected into the other rabbit at the same time. During the injection a little of the poison was lost, so that the animal did not receive the full dose, yet it died in thirty minutes.

Experiment 3.—April 4th, 1878. Guinea-pig, weighing $1\frac{1}{2}$lbs.; injected four centigrammes of cobra-poison into leg. 4.1 p.m., ligature applied immediately; permanganate of potash applied immediately. 4.5 p.m., twitching; 4.10 p.m., dying; 4.13 p.m., convulsion; 4.14 p.m., dead.

Experiment 4.—April 4th, 1878. Guinea-pig weighing 1 lb. 3.45′ 20″ p.m. Injected $\frac{3}{4}$ grain (= 4 centigrammes) of cobra poison, under skin of leg. A ligature was applied round the leg in one minute, and in five minutes permanganate of potash was rubbed into an incision made over the site of injection. 3.52 p.m., ligature cut; 3.53, twiching violently, leg paralysed; 3.57 p.m., dying; 3.58 p.m., dead—less than thirteen minutes.

Dr. Wall, who has carefully investigated the subject, makes the following pertinent remarks *Indian Snake-Poisons*, p. 129) : " As it was found that potassium permanganate does destroy the poison, steps were taken to see if it would be of any practical use in the treatment of animals suffering from snake-bite. It was found, by experiment, that a considerable quantity of potassium permanganate, dissolved in a weak saline solution, could be injected into the circulation of an animal without producing any immediate effect (I found the same with a strong solution). A dog, suffering from cobra-poisoning, had a cannula placed in its saphena vein ; a solution of potash was injected, but though a large quantity was cautiously and gradually introduced into the circulation, and though at the same time life was prolonged by artificial respiration, in no way was the least benefit to be perceived from the remedy. The reason is obvious. It is quite true that potassium permanganate destroys the active agent of cobra-poison by oxidising it ; but, when introduced into the blood, it of course commences oxidising indifferently all the organic matter with which it comes in contact; but it has no power of selecting one organic substance for oxidation rather than another. The oxidising power of the permanganate is, therefore, exerted on the constituents of the blood generally, instead of being reserved for the cobra-poison in it alone; so, if cobra-poison is dissolved in an organic solution, and the permanganate is added before injection, the poison suffers little, if any, diminution in strength, for oxidation has taken place chiefly at the expense of the other organic matter. Thus, it would be necessary to destroy all the constituents of the blood by oxidation before all the poison in it could be destroyed too. If a substance should be found having the power of oxidation, with a special affinity of exercising it on snake-poison, the problem of the treatment of snake-bite would be solved, but potassium permanganate has not the special power."

It has been pointed out that there are other substances which greatly diminish or destroy the action of snake-poison when mixed with it out of the body. Of all such agents, permanganate of potash is probably the best; still it seems to be of little practical use.

Wall further remarks : " It may be asked why, if metallic salts, tannic acid, hydrate of potash, and permanganate of potash, destroy snake-poison, should not these substances be used in preference to excision. The reply is obvious.

If we could know the exact position of the poison, and if there were only one deposit, we might probably succeed in destroying it by injection. But to remove the poison deposited by the bite of a snake requires a most intelligent observation, guided by eye-sight and judgment, but an injection of a chemical agent must be, to a great extent, made by guess-work, and the solution, instead of following the poison, takes the line of least resistance in the tissues, often leading it far from the poison."

In a pamphlet (*Experiments on Permanganate of Potash and its Use in Snake-poisoning*) dated 1882, Richards says: "A solution of 5 per cent. of permanganate of potash is able to neutralise the poison;" and recommends that this should be injected into the bitten part after a ligature has been applied; it is less likely to cause sloughing of the tissues than any other agent which could neutralise the venom. In his letter dated July 22nd, 1882, he says: "It is, in my experience, the best local application we possess. It is not a physiological antidote, but is a chemical one, and is utterly powerless to effect any influence on the lethal action of snake-poisoning." (He means the constitutional action.) He is of opinion "that whenever opportunity offers, the injection of permanganate of potash should be resorted to, assuming that a ligature has been efficiently applied (where it can be applied at all) within five minutes from the bite. In the average run of cases, the permanganate will certainly destroy the poison lying beyond the ligatured part," if it come in contact with it; but, as Wall pointed out, the difficulty of insuring its contact with the poison is so great as to render it practically unreliable. I agree with Richards that, so far as it goes, it is a good local application, and as such it ought to be used, or, in its absence, tannic acid or liquor potassæ might be resorted to with the same object; but as a constitutional remedy, as a physiological antidote, it is powerless, like all others that have been tried and failed to do good. Dr. de Laçerda himself, although he attributes the highest value to it as a chemical antidote, both as a powerful oxidising agent, and by the action of the potash, says; "as to the idea of finding a physiological antidote for snake-poisoning, I entirely agree with you that it is a Utopia."

Dr. de Laçerda's letter is most interesting and instructive. He says that he has been led to write it by reading the report of a discussion at this Society on April 16th, 1883. With some preliminary observations, he continues:

"I beg leave to protest against an opinion attributed to me by some of your colleagues, but which I have never sustained. I refer to the opinion that attributes to bacteria the effects of the poison. I have weighty reasons for considering such an hypothesis as entirely false. I recognised, indeed, by means of repeated and careful observations that the venom contains micrococcus in great numbers, and I made a communication on this subject some three years ago to the Academy of Sciences of Paris. These corpuscles, however, exist in the venom in an accidental manner, as also in the human saliva, and play no important part in the effects of the poison. This last acts as a chemical agent producing a rapid alteration in the molecular composition of the albumina which enters into the formation of almost all animal tissues. On the blood, given certain conditions, its effects are very rapid, almost instantaneous; the same happens with the nervous and other elements whose functions are disturbed immediately that the venom comes in contact with them. Now, such immediate action can never be attributed to bacteria. You see, therefore, that this unsustainable theory cannot be invoked in endeavouring to explain the neutralising effects of permanganate of potash.

"Having made this protest, I will proceed to indicate the points on which I cannot agree with certain of your colleagues and with yourself, in regard to certain questions relative to snake-poisons. In the first place, I do not consider it exact to say that this venom inoculated in the tissues of an animal, invades rapidly the organism.* On the contrary, numerous experiments made during three years have proved to me that the venom is slowly absorbed by fractions, acting first locally on the tissues in which it has been innoculated, the elements of which imbibe the venom little by little and fix it. This destructive local action is at times, of itself alone, sufficient to produce, a short time after the inoculation has been effected, general disorders of a reflex character which are not unfrequently confounded with the disorders due to to the generalisation of the venom which require a greater time for their manifestation.

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* Dr. de Laçerda may possibly have operated only with the crotaline snakes, and if so, he has not had the opportunity of witnessing the different action excited by colubrine poison. In my experience, frequent experiments showed that direct general contamination follows the bite even when no large vein has been wounded.

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"In those cases in which the effects of a generalisation of the venom were produced within a short time after the innoculation, some vessel had been opened by the inoculating instrument, giving the venom free entrance into the circulation.

" Another point in regard to which I cannot agree with some of your colleagues, is that there are species of snakes whose venom actuates principally upon the blood, while others act specially upon the nervous centres. For the Brazilian species, at least, I can affirm that this opinion is erroneous, and it does not appear to me probable that the species inhabiting India furnish an exception to the rule of unity of action of the venom, that I have verified for Brazil. With the venom from a single species, I may even say, of a single individual, an animal may be made to succumb by causing profound perturbations in the central nervous system, without apparent alteration in the blood ; or *vice versâ*, with slightly pronounced disorders of the nerve-centres and profound alteration of the blood. Everything depends on the conditions in which the experiment is made.

" Passing now to the essential point of the discussion that took place in the Medical Society, I will give in a few words how I comprehend and how I judge that the efficacious effect of permanganate of potash should be comprehended. You yourself, by experiments made in 1869, recognised that permanganate of potash mixed with the venom, took from it its noxious properties. Certain conditions of the experiments led you, however, to deny the efficacy of this chemical agent in the cases in which the venom had been inoculated in the tissues. As you know, however, I have demonstrated by numerous experiments and innumerable clinical facts that the neutralisation takes place even in the midst of the tissues, which makes this substance a chemical antidote of great value.

" The permanganate of potash acts upon the venom, destroying it in two ways : first, as a powerful oxidising agent ; second, by the potash that forms the base of the salt. Passing a current of nascent oxygen through a concentrated solution of the venom, this loses entirely its noxious properties. This experiment, which I have repeated many times, gave me always the same result. Let us suppose now that an individual is bitten. If injections are made in the place of the bite from five to ten minutes after the inoculation of the venom, this is promptly neutralised *in situ*, and the individual runs no further danger.

A great number of facts like this have been observed in Brazil. If aid is given late, hours after the bite, when the tumefaction of the wounded part is very pronounced, and the phenomena that indicate the entrance of the venom into the circulation have already declared themselves, injections repeated in various parts of the wounded member, parting from the wounds made by the fangs of the reptile, still give very good results. Nor is it difficult to explain the good results in this case. The venom, as I have said, acts first locally, and only enters the general circulation after the lapse of a certain time, and by portions. The permanganate of potash, meeting in the tissues with the venom, which is little by little diffusing itself, neutralises it in the various points where it has been diffused, and thus stops the source of supply. The entrance of new and successive portions of the venom into the general circulation being thus impeded, the organism takes charge of the elimination of what has already been introduced, and which was insufficient to compromise the life of the individual.

"We will now suppose a case of greater gravity, in which a vein is wounded, and there is a rapid penetration of a large quantity of venom into the circulation. Even here, an injection of a solution of one-hundredth of permanganate of potash may be practised in the vein, since we have recognised that no bad effects are produced in dogs by a dose of from two to three cubic centimètres. In this case, the good results are problematic, in view of the rapid diffusion of the venom in the organism; but then, if permanganate of potash does no good, no other substance could be useful. These cases, fortunately uncommon, are beyond all help.

"As to the idea of finding a physiological antidote for snake-poison, I entirely agree with you that it is a Utopia."

After careful consideration, fully admitting that in permanganate of potash we have an agent which can chemically neutralise snake-poison (as indeed was shown by Dr. Brunton and myself in 1878), I do not see that more has been done than to draw attention to a local remedy already known as a chemical antidote, the value of which depends on its efficient application to the contaminated part, which, Dr. Wall has pointed out, is too uncertain to be reliable. We are still then as far off an antidote as ever; and the remarks made by me in 1868 are as applicable now as they were then; they were as follows:—

"To conceive of an antidote, as that term is usually

understood, we must imagine a substance so subtle as to follow, overtake, and neutralise the venom in the blood, and that shall have the power of counteracting or neutralising the poisonous and deadly influence it has exerted on the vital force. Such a substance has still to be found, nor does our present experience of drugs give hopeful anticipations that we shall find it. But I repeat that where the poisonous effects are produced in a minor degree, or where the secondary consequences are to be dealt with, we may do much to aid the natural powers in bringing about recovery."

In conclusion, fully acknowledging the value of recent researches, I would express a hope that the subject may receive further vigorous investigation, and that efforts may be prosecuted, especially in the direction of search for some method of increasing elimination of the poison, of ascertaining the exact nature of the lesion of the nervous system and blood, and how far they are removable; that, as to local measures, with the view of preventing entry of the virus into the circulation, and of neutralising it *in situ*, improvements on present methods may be sought for. As to advance in the investigation of the physiological and chemical aspects of the question, much may still be done, as also in respect of the chemistry and microscopical character of the virus itself, and the blood and tissues of the poisoned. But these inquiries, of such importance to the human race, can, I fear, make but little progress whilst the present restriction on all physiological research continues to be maintained.

A review of the subject of snake-poisoning would be quite incomplete without acknowledgement of the valuable labours of such Indian observers as Dr. Short, Dr. Nicholson, and Dr. Stradling; Drs. Stuart, Ewart, Richards, and Wall, who have added materially to our knowledge, as also have Dr. Halford, in Australia, Dr. de Laçerda, in Rio de Janiero, Dr. Lauder Brunton, F.R.S., in London, and Drs. Weir Mitchell and Reichardt, in America, who are now engaged in the most important and much needed investigations into the chemistry of the poison, and the condition of the blood and tissues of the poisoned.

I am indebted to the Director-General of the Army Medical Department for the following interesting case, which will appear in the next *Army Medical Department Report.*

Colonel M., while serving in Zululand, near the lower

Tugela river, was bitten in the leg just below the knee, and, after the lapse of a few seconds, became sensible of extreme shock, and at once felt certain that a snake had bitten him. He rode back to camp, and, when first seen, ten minutes after the infliction of the injury, was in the following condition. There was pain, ecchymosis, swelling, and partial paralysis of the bitten part. He was so exhausted that he had nearly fallen off his horse. The forehead and hands were bathed in cold perspiration; the extremities were cold and pale; there was great nervous depression, with sense of impending death; respiration was hurried. Quickly following this, bilious vomiting set in, with loss of co-ordinating power; numbness of extremities and lips, and dragging sensation of the face; intense pain in neck, troublesome cough, with thick viscid expectoration. The pulse was, from the first, weak and rapid, rising from 120 to 150; restlessness and anxiety became very distressing. Vomiting ceased at 9 p.m., but soon afterwards still graver symptoms developed; vision rapidly failed; the eyelids drooped, the speech became thick and nasal; there was paralysis of the tongue and soft palate, with dysphagia. The were also chronic convulsions of the upper extremities of the muscles of the chest; the breathing was stertorous, with low muttering. At 12.45, he spoke for the last time, and then lapsed into a semi-comatose condition, and died at 2 a.m., ten hours after the bite.

Tight compression was made above the seat of injury, between the bite and the heart; wound enlarged, and an attempt made to remove all the blood and poison from it. Nitrate of silver and ammonia were applied freely to the surface of the wound. Ammonia and diffusible stimulants were administered by mouth. To relieve the distressing vomiting, sinapisms were applied to region of stomach, and brandy, with soda-water, given; the restlessness was combated with hypodermic injections of morphia (half a grain for a dose); the morphia gave great relief, which, however, was only transitory. Hot water-bottles were applied to the feet, and stimulants were given with an unsparing hand, but were not always retained. Ammonia was also injected subcutaneously.

Post mortem examination made nine hours after death; body well nourished. Cadaveric rigidity well marked. Hypostatic congestion. Great discolouration of scrotum and finger-nails. Situation of bite on left leg at upper and inner side of calf, about three inches below internal con-

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dyle of femur, and immediately over internal saphena vein. Appearance that of a small pin-puncture; lower part of leg rather swollen. On removing the skin from the region of the wound, there was found great sero-sanguineous extravasation into the surrounding tissues, and the muscles were soft and infiltrated with blood; the internal saphena vein was punctured. The venous system on the left side much congested. The glands in left groin, in long axis of limb, enormously enlarged and congested. Glands in right groin normal; pericardium normal. Heart, right cavities of, full of fluid blood; left cavities empty; valves healthy; no clots. Lungs normal. Liver congested, and slightly enlarged. Gall-bladder fully distended. Spleen somewhat enlarged, otherwise normal. Stomach slightly congested, rugæ well marked; contents, a small quantity of glairy mucus. Kidneys normal. Omentum contained much adipose tissue. Intestines normal. Bladder normal, contained a small quantity of urine. Brain somewhat congested, otherwise normal. Blood in a fluid state.

The snake which inflicted the fatal wound was not seen; in all probability Colonel M. trod on one asleep, which then struck at him. The systemic shock was at once apparent after receipt of the injury, which is accounted for by the puncture of the internal saphena vein, and the introduction of the poison direct into the general circulation. The clothing traversed by the fang of the snake was, first, cloth garter; second, khakee riding-breeches; third, drawers of light material. From the high situation of the puncture, the opinion of competent judges was that the snake which inflicted the wound was a "black mamba," one of the large African vipers, species not determined.

The following were exhibited :—

Crania of innocent snakes.
Crania of venomous colubrine snakes.
Crania of viperine snakes.
Dissections of muscular apparatus for erecting fangs.
Dissections of poison gland and duct.
Models of fangs.
Drawings of the above.
Also coloured figures of venomous snakes of India.
The following snakes were exhibited :—

Naja tripudians, bungarus ceruleus, bungarus fasciatus, callophis, elaps corallinus, daboia russellii, echis carinata, vipera rhinoceros, vipera cerastes, lachesis mutus, crotalus durissus, pelias berus, and several non-venomous snakes.

ON

THE ORIGIN, HABITS AND DIFFUSION OF CHOLERA, AND WHAT MAY BE DONE TO PREVENT OR ARREST ITS PROGRESS, AND TO MITIGATE ITS RAVAGES.*

WHEN the Committee of your Association did me the honour of inviting me to address you on the subject of cholera, I hesitated to comply with the request, because it appeared to me at first sight unsuited to a general audience. On reflection, however, I thought that in a topic of such universal interest, which has been, nay is, so prominently before men's minds, I might find matter which would give effect to the wishes of the Committee and also be of service in conveying information which all should possess, with regard to the opinions they should form, the attitude they should assume, and the action they should take in behalf of the public weal, whenever cholera menaces or has actually invaded this or any neighbouring country. I propose therefore to give you some account of a disease which has extended its ravages over much of the earth's surface, and has destroyed so many of the human race; which is uncertain and apparently capricious in its incidence, terrible in the force and rapidity with which it often strikes, and obstinate in its resistance to therapeutic measures.

The true cause of cholera is still unknown, but the laws which affect its origin, propagation and diffusion have been so far ascertained by observation that, happily, the measures by which its progress may be stayed and its fatality mitigated are now well known to be within the scope of sanitary preventive operations. Moreover we are encouraged to believe that not only may it be disarmed of much of its present terrors, but that, in the future, we may anticipate a great diminution of its intensity, or, it may be, as in the case of such great epidemics as the "Black Death," and "Sweating Sickness," and others which desolated Europe

* A Lecture addressed to the Young Men's Christian Association, at Exeter Hall, 2nd March, 1886. Col. the Lord Wantage, K.C.B., V.C., presiding.

in the middle ages, that it will take its place among the records of the past.

The subject of my lecture, then, will be the Natural History of a pestilence which is becoming yearly of greater interest, and I hope to tell you something which I trust may modify erroneous notions as to its character and attributes, and to shew you how you may help in preserving yourselves and others from its evil effects.

I have to tell you of a pestilence which sweeps over vast areas, leaving desolation in its track; whose origin, nay, even pathology, is still involved in obscurity; whose breath is fatal as the shade of the fabled Upas tree; whose mission is like that of the destroying angel of the Apocalypse. But I have also to tell you how its fatality may be diminished, and how a country—when duly prepared—may regard its approach with confidence, if not with indifference, not trusting in quarantine or other oppressive and restrictive measures, which are as noxious as they are futile, but placing firm reliance on the efficacy of Sanitary Science to cope with and overcome the evil, if only its practical teaching be attended to, for on that alone can any reliance be placed.

It may be well to make a few preliminary remarks for the benefit of those who do not already possess the knowledge, on what is meant by the terms epidemic, endemic, sporadic and zymotic.

The term *epidemic* is of Greek origin and signifies "upon the people"; it is applied to disease either when it is diffused far and wide, ranging over extensive countries and often leaping as it were by bounds to others, or when it spreads among more limited communities, following a definite track, dying out rapidly, or after one or more revivals or recrudescences, in the localities in which it had previously prevailed.

The term *endemic*, on the other hand, is applied to disease which is peculiar to certain localities, is always present, and depends on local causes; it may, under some conditions, assume the epidemic character, when it passes its ordinary limits and is diffused far and wide in varying degrees of intensity.

Sporadic, (from σπειρω, I sow) is applied to isolated cases which may occur anywhere, from causes peculiar to each case; such often herald the approach of the same disease in an epidemic form.

Cholera assumes all these forms; it occurs sporadically in

many places, is endemic in Bengal and other localities, and rages from time to time over various parts of the world in an epidemic form. The same may be said of the plague, small-pox, scarlet fever, and some other diseases. I use the term epidemic in its simple technical sense, as applied to disease prevailing and spreading among the people. As to what else may be implied hypothetically in the term, I have only to say that I understand it to mean something superadded, whether of atmospheric or cosmic origin, without which disease would not be generally diffused. This has been called (by Dunglison) "the epidemic constitution," whilst Léon Colin describes it as "a something isolated, impersonal, detached from the disease itself, the epidemic genius [constitution, influence], a certain creative force of the different epidemic affections, compelling, directing, extinguishing them."

These definitions, however, define nothing; the fact is we do not know the real nature of that which is implied in the term "epidemic influence or intensity"; but we do know that it means a potent—often the most potent—factor in diffusing disease. It may be, I suppose, referable to certain meteorological conditions, taking that expression in its widest sense; something either propagated in great telluric or aerial currents, or prevailing in cyclical periods simultaneously in various regions of the earth's surface; co-operating with local causes in conferring on the disease its quality of epidemicity, in some cases, perhaps, the combination itself acting as a cause.

Whatever this influence really be, epidemic prevalence does not occur without it, and this is so not only in such diseases as influenza or cholera (where the question of contagion is at least doubtful), but in the most contagious, such as scarlatina and small-pox; for it seems pretty certain, that whatever part contagion may play in the etiology of disease, it is of small importance relatively to this influence in diffusing the disease.

Dr. Southwood Smith has pointed out that there is much in common in the nature of epidemics, however they may vary in their special characters; that, in their propagation, development and diffusion they are subject to this influence. That in some, such as scarlatina and small-pox, there is a special exciting cause such as has conferred on them the term zymotic, cannot be questioned; but in others such as influenza or cholera, this is not so certainly made out, and

it is still a question to be solved, whether these may not owe their origin, as well as their diffusion, to more general causes.

Epidemics are fevers; "cholera is a fever which appears in its true character when not immediately fatal, and when time is allowed for the development of its successive stages." They resemble each other in the extent of their range and the manner of their diffusion. They sometimes give warnings of their approach by the outbreak of some milder epidemic, and, it has been said, "by the modification of the type of existing diseases, or by the transmutation of ordinary diseases into something more or less resembling that which is at hand." It would appear that they are occasionally preceded by influenza; this was the case in the visitations of cholera in 1831 and 1848.

They are sometimes actually in operation in a place before they assume their distinct form; *e.g.* diarrhœa may prevail before cholera breaks out. "They resemble each other in their migration;" advancing by leaps they come to their height, decline and disappear in one locality, attack another, pass through the same process, proceed to another and so on to a fourth, fifth, and sixth; the same resemblance is seen in the periodicity of their return.

The predisposing causes are external and internal.

External are vitiated air or water, overcrowding, sewer gases, stagnant subsoil moisture, and other insanitary conditions; such are also called "localizing causes." Internal causes are such as render the blood impure.

The atmosphere, without being vitiated by such causes, undergoes natural changes which predispose to the spread of epidemics. It is quite certain (says Dr. S. Smith) that there is an epidemic meteorology. Mr. Glaisher took the first steps towards bringing this matter within the purview of science, having studied it during three cholera epidemics. This department of Epidemiology is making progress and promises to yield important results. I may say it is now the subject of careful investigation by a well-organized Meteorological Department in India.

Variation in atmospheric pressure, extraordinary stillness of the atmosphere, deficiency in the tension of positive electricity or of rainfall, absence of ozone, fogs, blights, low forms of life in the air, all have been regarded as possible predisposing causes. Attention has been called more than once to the disappearance of birds from cholera-affected

districts at the beginning of the outbreak. The dreadful outbreak of cholera at Kurrachee in 1846 was (it is said) preceded by days of intense stagnation of atmosphere, and others have been preceded or attended by similar phenomena.

Some believe that the predisposing causes may themselves become efficient primary causes, and that the outbreak of epidemics may be prevented by placing the population under favourable sanitary conditions; that the prevalence of certain local causes in addition to certain general conditions of the atmosphere may bring about the changes in the person which are required to engender widespread disease; that the existence of a distinct primary cause is not necessary to account for the phenomena. The general opinion is, however, that joined to the predisposing causes there is a primary cause, a distinct entity, which may travel from one part of the globe to another, capable of spreading over space however large, or of confining itself to any space however small; such is the supposed cholera germ or particulate poison, said to be capable of increasing to any extent under favourable circumstances.

The advocates of this belief have been most energetic of late in their researches among bacterial life for the primary cause, and a therapeutic application of it has recently been witnessed in inoculation experiments for cholera in Spain, of the futility of which—by the way—there can be little doubt.

The specific germ or poison, from its analogy to ordinary ferments has been called "zyme," and hence the term *zymotic* given to epidemic diseases.

It is remarkable that while some epidemics spare the natives of the country and affect foreigners, others—such as cholera—affect all.

History of Cholera.—The epidemic which concerns us this evening is Cholera; let me give you a brief sketch of its history.

First as to the word itself:—Hippocrates uses the word "χολερη," this being the Ionic form of "χολερα."

The chief opinions as to its derivation are:—

1. From χολη = bile and ρόια = flux;
2. From χολερα = the gutter of a house.
3 From χολας = an intestine.
4 From χολος = the old form of χολη, χολερη being ‛η χολερη νοσος Δ. = the bilious disease.*

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* Macpherson. Annals of Cholera.

The Hindostanee and Arabic names are "murree" and "taoun" and "wubba," but these really mean "deadly pestilence," and the Chinese "ho-louan" and French "trousse-galant" come under the same head. It is doubtful, however, if the latter were really cholera..

The specific names for cholera are generally derived from its most important symptom, *i.e.*, derangement of the alimentary canal. The oldest and most widely spread name is "haiza," a term common now in India where Hindostanee is spoken, used by Rhazes (900 A.D.), by Avicenna a century later, and by Averrhoës in the 12th century.*

The term found by the Portuguese in use at Goa was "mordeshee," and Europeans continued to use that term for some time under the forms "mordshi," "morshi," "morexi," "morexin," "mordexin," "mordeshin," and "mort de chien."*

The local names employed in the East are most of them descriptive of the characteristic symptoms, *e.g.*

Bengalee = Oola-oota.
Mahratta = Morshi, Tural.
Chittagong = Mou-pet.
Cashmeree = Dakee.
Malay = Moontaan.
Deccanee = Dank lunga.*

Let me now give a brief outline of the general characters of the disease itself; a clinical or pathological account would be out of place here, but enough must be said to render what follows intelligible.

There are certain erroneous notions about cholera, and one assigns that name to the disease in its most fully developed condition alone; now this is a mistaken conception, and one which gives an incorrect impression of its extent and fatality. The fact is that it presents many phases and symptoms, varying in gravity from simple malaise to profound collapse or the comatose condition of the worst forms of fever. Sporadic cholera is often spoken of as though it were a different disease to the epidemic, malignant, or so-called Asiatic cholera. I cannot stay to discuss this; for my own part, I believe cholera is cholera wherever it occurs, and its epidemic prevalence and intensity are phases or accidents in its history.

Cholera manifests itself in several stages or degrees, the

* Macpherson. Annals of Cholera.

earliest being merely malaise and general uneasiness; this is followed by the more serious symptom of bowel derangement, which soon passes into incessant catharsis and emesis of clear rice-watery fluid; this—very rapidly in some cases—causes a state of collapse which frequently proves fatal, or, if reaction occur, fever follows, with a variety of complications not less dangerous.

The mortality of cholera is great when it has advanced to the condition of collapse or secondary fever. In an epidemic, perhaps half die. Death is generally due to exhaustion from depression of vital energy and the loss of the serous part of the blood, from uræmic poisoning or from pulmonary or cardiac embolism, or from the complications attending consecutive fever. In some severe outbreaks death occurs very rapidly, as if from shock, in a few hours. The fatality appears to vary in different outbreaks, which are influenced in intensity by local causes as well as by epidemic force. The part played by meteorological conditions, no doubt, is important, and the effects of season and locality are marked, as I shall have to tell you later.

The suddenness and violence of some attacks are so remarkable as to make it obvious that some factor—apart from contagion or insanitary conditions—is at work. It has generally been observed that the cases at the outset of an epidemic are more numerous and fatal than later on, and as it gradually declines in intensity, the cases become less severe in character, next less numerous and severe, and finally cease altogether. This is not peculiar to cholera; it occurs in other epidemics, and was specially noted by Defoe in his account of the plague in London in the 17th century.

The patient's appearance and condition are strikingly significant when the disease has assumed its developed stage. The pinched, shrunken, livid face, hollow eyes with darkened areolæ, the cold clammy skin, the corrugated fingers, the cold breath, the sunken, hollow, husky voice, the incessant discharges, the raging thirst, the cramped extremities, the failing pulse,—all eloquently and sadly proclaim the true state and extreme danger of the sufferer. I shall give you some illustrations of the extent of this danger.

Now to proceed to the history of cholera. In the pre-Christian era cholera is described by Hindoos, Chinese, and Greeks.

Ancient writers on Hindoo medicine do not give a very

definite account of the disease, nor do they describe it in an epidemic form. The Ajurveda of Suçruta has a description of "Visuchika," generally supposed to be cholera, but later Sanscrit works say little on the subject.*

Records of Chinese medicine are usually considered to be contemporaneous with, or much earlier than Hippocrates (5th century B.C.). Ho-louan is the Chinese name for cholera; there is no evidence, however, of its having been known in China in an epidemic form.

Hippocrates describes cases of cholera: *e.g.*, those of Eutychides, Bias the pugilist, &c.;* but though affirming it to be more frequent at certain seasons, he describes no epidemic. Both he and the Chinese mention two forms—the damp and the dry.

The idea that cholera was known to the Hebrews proceeded from a wrong translation of the words "choli-ra," adopted in the Septuagint and Vulgate; this was rectified by Luther in his translation, and the idea is now abandoned.*

After the Christian era, cholera is frequently mentioned by Roman writers, Celsus, Aurelianus, and Aretaeus of Cappadocia; by later Greek writers, Alexander of Tralles, Paulus Ægineta; by Arab writers, Rhazes (A.D. 900), Avicenna, Averrhöes, Ali Ben Hossein of Bokhara (1364), &c.* The 13th, 14th, and 15th centuries are very barren concerning annals of medicine, but from Bernard Gordon, Raphael of Volterra, and others, we learn that cholera was a well known disease in Europe.*

In India it was not observed by Europeans before 1503, though an instance is given by Mr. Dowson in his edition of Sir Henry Elliot's "History of India," of what may have been cholera in 1325.*

In Europe, from the beginning of the 16th century, there are notices of epidemics of bowel affections and of a disease called "trousse-galant," which appeared in England and France in 1545. The earliest epidemic of cholera described by name occurred at Nismes in 1564. An outbreak at Ghent, in 1643, is described by Van der Heyden, and another occurred there again in 1665.† The epidemic that raged in London from 1669-82 is called by Sydenham

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* Macpherson. Annals of Cholera.

† Macpherson, Op. cit., and Scoutetten, Histoire chronologique, topographique et etymologique du choléra.

cholera,* but by Wills only an aggravated form of dysentery.

According to Dr. Macpherson, cholera was present in various parts of Europe in a mild epidemic form during the 18th century, dying away towards the end, and remaining quiet during the first years of the present century. Previous to the 19th century, outbreaks in Europe seem to have been less severe and less widely diffused than those in India, but it must be borne in mind that the records of disease were very imperfect in those times.

In the East, cholera was first observed by the Portugese in 1503.† The first epidemic outbreak occurred at Goa in 1543; it was observed by Gaspar Correa, and the following is his description of it:—

"In the spring of this year there appeared a mortal throe, which those of the country call moryxy, common in all classes of people, no less to the child at the breast than to the octogenarian—to the stalled beast and the domestic fowls also, for it was common to all things living; nor could any reason be assigned for this agonizing infliction. The sound as well as the sick fell victims to it, and nothing did it respect. This dolour struck on the stomach; so grievous was the throe, and of so bad a sort, that the very worst kind of poison seemed to be taking effect, as proved by vomiting, with excessive thirst for water accompanying it, as if the stomach were parched up, and by cramps that were fixed in the sinews of the joints and in the soles of the feet, with pain so extreme that the sufferer seemed at the point of death. The eyes were dimmed to the sense, and the nails of the hands and of the feet black and curved. For this disease none of our physicians found a cure. The patient barely lived the day, or at the most the night through, in such sort that of 100 attacked scarcely 10 escaped, and they used native remedies. So great was the mortality that the bells tolled all day long. There were 12, 15, or 20 burials daily. At last the Governor ordered that the bells should be tolled no more, as their tolling increased the alarm. The Governor ordered the physicians to examine a dead body; but they found nothing in the body, but the stomach shrivelled up like a piece of leather."†

* Sydenham's Works, translated by Swan. Page 133.
† Macpherson. Annals of Cholera.

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Compare this with epidemics of cholera that occur now and the identity will be apparent; the outbreak at Kurrachee, for instance, which will be described later.

In the 17th century a full account of the disease is given by Bontius, who describes it in Java in 1629; Zacutus Lusitanus notes its prevalence in Arabia; Baldaeus, a Dutch clergyman, refers to fatal cramps in his accounts of the coasts of India (1641); Cleyer noticed cholera in China in 1669; Thevenot was attacked by it near Surat in 1666, and Then Rhyne, a Dutch Professor, who wrote towards the end of the 17th century, mentioned a remedy employed against it in Japan.* Cholera appeared in an epidemic form in Mewar in 1661, in Marwar in 1681-82, in Goa in 1683-84.*

During the 18th century cholera visited in an epidemic form Pondicherry and the coast in 1768-69, and Ganjam and Calcutta in 1781; it appeared also in Java, China, and the Mauritius, and is reported to have occurred in an epidemic form at Tinnevelly in 1757, on the Malabar coast in 1782, at Hurdwar and Madras in 1783, at Travancore in 1792, and in Mewar and the Mahratta country in 1794.*

Of these epidemics the most widely extending was the outbreak at Ganjam in 1781; it branched off in a northerly direction, but was not traced further than Calcutta; it appeared in Central India and Hurdwar in 1783, in Madras in 1782, and extended as far south as Trincomalee. After this outbreak notices of the disease become rarer until the great epidemic of 1817.

I shall continue the history of cholera in a brief summary of its great epidemic movements since 1817 up to the date of that which is now hovering over Europe, and has recently manifested itself with great intensity in France, Spain, and Italy. These are, according to Hirsch, arranged in series called Pandemics.

The pandemic of 1817-23 was almost confined to Asia, Astrakhan being the only European locality attacked.

Cholera devastated India from end to end, attacked Ceylon, Mauritius, Réunion and the East coast of Africa (1820). It broke out in Burmah, Siam, several of the East Indian Islands, and finally in China and Japan in 1822. In 1821 the epidemic was at Muscat, in Mesopotamia and the North East provinces of Persia. In 1822 it appeared in

* Macpherson. Annals of Cholera.

the West of Persia, attacked the North of Syria, broke out in the following year in Palestine, in Antioch, in Damascus, in towns of the Transcaucasus, and in Astrakhan on September the 22nd.*

The second pandemic (1826-37) extended widely over Europe, Asia and North America, and appeared on the West coast of Africa.

In 1827 cholera was in Cabul, Balkh and Bokhara; in 1828 in Khiva and among the Kirghese hordes. East Russia was again the first European place attacked, cholera appearing in 1829 at Orenberg and Astrakhan : it became very widely diffused over Russia during 1830. During 1831 and 1832 the epidemic appeared in Turkey, and in all the Northern and Central countries of Europe—except Denmark—and attacked, for the first time, North America (Canada and the United States) in 1832.

In 1833 Spain and Portugal suffered and the epidemic was severely prevalent in the United States, and appeared on the Pacific coast and in Mexico.

At the end of 1834 cholera broke out in the South of France; appeared in South America for the first time in 1835, and in the same year in Italy, where it became widely diffused during 1836. During 1837 cholera was in Malta, Sicily, Austria, South West of Germany and Central America (for the first time). It died out, however, by the end of the autumn.

Besides the places already mentioned in Asia, cholera attacked China (1830), Japan (1831), Persia (1829), Mesopotamia, Arabia, Syria and Palestine.

In Africa, cholera appeared in Egypt (1831), Algiers, Abyssinia, Zanzibar, and some of the Soudan countries.*

The third pandemic (1846-63) extended over the whole of the Northern hemisphere to 25° South in the Old World and to 30° South in the New World.

It can be divided into two periods, 1846-50 and 1852-63.

During the first period (1846-50), in Asia, cholera was widely diffused over India, Turkestan, Afghanistan, Persia, Mesopotamia, the coast of Arabia, and Syria.

In Europe it appeared in Orenberg in 1847. With the exception of Spain and Portugal, the disease extended over the whole of Europe, but was not very widely prevalent in

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* Hirsch. Handbook of Geographical and Historical Pathology.

the South and East of Germany, in Norway, Denmark, and Ireland.

In America, cholera appeared in New York and New Orleans at the same time (1848), and over-ran all the states to the east of the Rocky Mountains, and attacked San Francisco, Mexico (1849), California, Panama and New Granada.

In Africa, cholera was in Egypt and countries of the Northern coast.

There was a general lull from 1850-2, isolated cases only being reported in the north and north east of Europe.

During the second period, of places in Asia, India suffered severely in 1852-58-60-61 ; there were epidemics also in China, Japan, the East Indian Islands, Persia, Afghanistan and Turkestan.

In Europe, the disease appeared again in East Russia, Prussia and Poland. The whole of Europe suffered, the Northern and Central countries being the first attacked ; the epidemic had died out by 1856, but re-appeared in Hamburg and on the shores of the Gulf of Finland in 1859, and a few cases occurred in England during the same year.*

In America, the area of epidemic prevalence was almost co-extensive with the northern continent. The disease appeared in South America, attacking Brazil for the first time (1855), and Venezuela ; it broke out also in Central America.

In Africa, cholera attacked Algiers and Morocco (1853), Egypt, Nubia, Abyssinia, West coast of Madagascar (for the first time), Cape Verde Islands, Madeira, Mauritius and Réunion.†

The fourth pandemic (1865-76), can—like the preceding one—be divided into two periods, *e.g.*, 1865-69 and 1871-75.

In Asia, during 1863-64 cholera was widely diffused over India, Ceylon, the East Indian Islands, China, Japan, West and South coasts of Arabia (1865), Persia, Mesopotamia and Syria.

In Europe, the epidemic appeared in the summer months of 1865 in Malta, France, Italy, Spain, Belgium and Russia. In the latter country cholera was heard of every year till 1874. It subsequently invaded every nation in

* Cuningham. Cholera—What can the State do to prevent it ?
† Hirsch. Handbook of Geographical and Historical Pathology.

Europe except Greece,—Denmark, however, being very slightly affected.

In America, the West Indies was the first locality affected (1865). During 1866 the disease was widely diffused over the United States, appeared in Central America and attacked the River Plate States and the west coast of South America for the first time; it was also prevalent in Bolivia, Peru, Brazil (1867-68), and British Honduras.

In Africa the epidemic was very widely diffused, attacking Somali land (1865), Zanzibar (1869), Madagascar, the Mauritius (1867), Egypt, Nubia and Abyssinia (1865), Senegambia (for the first time), Algiers, Tunis and Morocco.

During 1869-70 there was a lull, cholera persisting at very few points of the globe outside India; Russia, however, being one of the points.*

During the second period (1871-75) the Asiatic countries attacked were Persia (in which cholera had been present since 1856), Mesopotamia, Arabia, Turkestan, Bokhara, Syria (1875).

In Europe during 1871, cholera was gradually diffused through Russia. During 1872 and 1873, Russia, Poland, Prussia, Austria, Turkey and Sweden suffered severely; other countries suffered less and Denmark again escaped entirely. By 1874 the disease had died out in most countries of Europe, except in Hungary and other central parts.*

In America in 1873, cholera broke out in New Orleans and attacked many states on the banks of the Mississippi and in the interior plains.

In Africa, cholera appears during this epidemic to have been limited to Egypt (1871 and 1872) and Nubia (1872). †

A fifth pandemic which still continues, first appeared in Egypt during the summer and autumn of 1883.

It began at Damietta—where a fair had recently been held—and subsequently attacked Cairo and other towns, affecting so many districts that they could not be quoted in official returns. There was also an outbreak among the British troops at Suez.

The epidemic of 1883 was restricted to Egypt. The entire number of deaths is not given, but up to the end of July the deaths notified to Sir G. Hunter were 12, 600—the

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* Cuningham. Cholera—What can the State do to prevent it?
† Hirsch. Handbook of Geographical and Historical Pathology.

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real number being probably about twice that amount. The condition of the country is described as one of an extremely insanitary nature.

In 1884, cholera appeared at Toulon on June 18th, and a week afterwards it appeared at Marseilles, and subsequently attacked many towns—Arles, Aix, Perpignan, &c. —in the south east of France, where it continued till the middle or end of September.

During July it was gradually increasing in France, and appeared in a mild form at St. Petersburgh and Charkoff.*

In the beginning of August cholera was in Lombardy and by the end of the month was diffused over the greater part of northern Italy, raging most severely in Spezzia.

In September it appeared in Naples and was prevalent there in a virulent form throughout the month. In Italy, during the year there were 27,030 cases and 14,299 deaths.

In October cholera was dying out in all districts that it had yet attacked, but at the beginning of the month it broke out at Yport in Normandy, was reported in other parts of northern France, including Nantes, and finally appeared in Paris on November the 5th, where it was active till the end of the month, there being during that time in the city 971 cases and 866 deaths.

During 1884 cases occurred in two English ports,—Cardiff being one,—but failed to spread inland.

In 1885 cholera was prevalent in Spain from June to November, and during that time attacked nearly all the provinces of that country. It was first reported in the provinces of Valencia and Castellon during the last week of March; by the end of May it began to diffuse, attacking Madrid in June and spreading over many provinces, amongst them Saragossa, Toledo and Alicante. By the end of the month the mortality had reached 5,700.

During July many more provinces were involved, and the disease became much more severe in districts already attacked. The mortality for the month was not far short of 24,000.

At the beginning of August the epidemic was still increasing, but by the 7th it had reached its height and declined steadily during September. The mortality for August was 45,000 at least; for September rather more than 13,000. Twenty-four deaths took place within the British lines.

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* Cuningham. Cholera—what can the State do to prevent it.

The total number of recorded deaths from cholera in Spain was 79,490, but 100,000 is nearer the real number. Valencia (13,400) and Saragossa (10,954) registered the greatest number of deaths.

Cholera appeared in August at Marseilles and Toulon; in November in Brittany,—Brest, and the immediate neighbourhood being affected.

Meanwhile, in September it had appeared in Parma, where there were 313 cases and 202 deaths, in Ferrara, Reggio, Massa, Rovigo, Genoa, Modena and Venice; during this year, however, in Italy, the disease scarcely reached the height of an epidemic.

In Sicily, cholera was prevalent during September and October; in the whole island there were 6,397 cases and 3,409 deaths, of which 5,535 cases and 2,959 deaths took place in the town and province of Palermo.

In 1886 up to this time, the epidemic has been comparatively inactive; there was an outbreak, however, at Tarifa, in the Straits of Gibraltar, in the first week of February, and between 700 and 800 cases of cholera have occurred in the province of Finisterre since the beginning of December, 1885. There are also rumours of the disease at Venice and Trieste, and it is not improbable that a fresh recrudescence will take place later on in the year. Our own island has hitherto been almost exempt, but no vigour should be relaxed in the observance of sanitary measures, by which alone we can prevent its development.*

Etiology of Cholera.—It is not without reason that some have suggested that cholera, influenza, and malarial fevers are only different manifestations of a common disease. They frequently prevail at the same time, and have such community of symptoms that it is sometimes difficult to determine between them, more especially in time of epidemic prevalence and in certain stages. Cholera frequently simulates malarious fever, and in certain epidemics in India it has been difficult to say to which the disease should be assigned. For instance, Dr. Ross, referring to the outbreak at Amritsar in 1881, says: "Fever in the city did not appear in an epidemic form until September; it was preceded by cholera about the beginning of August, of an

* The particulars of this epidemic are taken from various numbers of the *Lancet* for 1883-84-85, from the *Practitioner* for January, 1886, and from the *Morning Post* of Monday, February 8th, 1886.

extremely fatal type, and later on, when masked by fever, there was some difficulty in recognising it. . . . The two diseases, cholera and fever, supposing them to be distinct, masked one another so effectually, that diagnosis was extremely difficult at times."

Then again with reference to another outbreak, he says: "I observed in Kohat, in 1869, an outbreak of fever very similar to the Amritsar epidemic, followed by cholera. It was then observed also that it was an impossibility to tell when the cholera commenced, the symptoms of many cases of the fever being so similar."

It is admitted that season plays a great part in the etiology of fevers and influenza, and with regard to cholera, it is conceded that the character of the epidemic season, depending on meteorological influences, is important in determining the type of the disease.

The malaise or general discomfort in cholera, the premonitory, and next, the colliquative diarrhœa, vomiting and collapse, correspond to febrile malaise, the intermittent or algid state, and the remittent or pernicious bilious forms with collapse, in fevers; in influenza to the premonitory chills or malaise, the catarrhal, bronchial, febrile symptoms, and the depression and complications which often make the disease so severe in epidemics, so fatal—in some cases quite as fatal as cholera.

For instance, in 1564 there was a very destructive epidemic of influenza in Spain, during which 10,000 people died at Barcelona alone. The epidemic of 1580 was very widely diffused in the East, in Africa, and in Europe—affecting Denmark, Sweden, Germany, Hungary, Turkey, France, the Netherlands, Spain, and Portugal. In Paris alone 40,000 died.* Sir Thomas Watson writes, "On a cold night, says Maertens, the thermometer rose 30° F. in St. Petersburg; the next morning 40,000 people were taken ill with influenza, but every epidemic is not preceded by similar changes in the temperature, for, as Dr. Hancock observes, there has not been any uniform connection between any one sensible quality of the atmosphere—as to heat or cold, rain or drought, wind or calm,—and the invasion of the epidemic. Irregularities and vicissitudes of weather have, however, gone before the disease in very many instances, but sometimes one condition of the atmos-

* Hirsch. Handbook of Geographical and Historical Pathology, and Haecker, Epidemics of the Middle Ages.

phere, sometimes another has been its immediate forerunner, and the epidemic has frequently been observed to fall partially and capriciously, as a blight falls upon a field or a district. Petit informs us that in 1775 the disease in France was ushered in by thick noisome fogs, and I may here call to mind the dense fog which prevailed over this city in the raging of the distemper in 1857.

"Influenza travels or migrates from one place to another and holds for the most part to certain courses, in spite of opposite winds and variations of temperature. It has been noticed that it generally follows a westerly or north-westerly direction—in this resembling epidemic cholera. The body of the epidemic is preceded by dropping cases, like the droppings of a thunder shower, is most violent at its commencement, and is generally over in six weeks. Conjecture has not been idle as to its origin; one hypothesis assigns it to change in the electrical condition of the air, or to magnetic currents. Schönbein thought it was caused by abundance of ozone; all this is sheer hypothesis, but I have nothing better to offer you. That which commends itself to my own acceptance is the ozone hypothesis. The absolute mortality under the epidemic of 1857 has been immense, though the relative mortality was small. More persons have died in the present year (1857) than died of cholera when it raged in 1832." In these particulars there is a close analogy to cholera.

There are several theories of the causation of cholera; briefly expressed they are:—That a miasmatic poison is absorbed, either by the lungs or intestinal canal, which produces a primary disease of the blood, and that the virus multiplies and causes disturbance of the vital functions. What this virus is, or whence it comes, is not stated.

A second theory asserts that the diffusion of the disease is effected by human agency, by means of a poison in the persons or effects of those who have been exposed to it, this poison being inhaled, or swallowed in water or food.

The water theory assumes the propagation of cholera by means of drinking water which has been contaminated by the specific germ contained in cholera discharges; it has, universally, many advocates.

A modification of this theory assumes that, to produce cholera, the germ must be in a certain vibrionic stage of decomposition. This germ may be preserved in a dry state for years, but whether fresh or old, it undergoes rapid

changes in water. Oxidisation, acids, and certain degrees of temperature, both high and low, can render it harmless.

Pettenkofer believes that the cholera germ is developed in a damp, porous soil, impregnated with organic matter. The germ must remain in the soil some time before it acquires poisonous characters; it then rises into the air and effects an entry into the bodies of people by means of air, food, or water. The germs, further developed and multiplied, are expelled in an immature state, again get into the soil, and remain there till mature; in this way an epidemic is produced. In considering the effect of traffic on the transmission of cholera, he asserts that the dejecta are not the only means of spreading cholera, and that possibly, in that way, they are quite harmless. According to him, the above conditions, combined with personal susceptibility, must concur for the production of an epidemic.

In 1883, Dr. Koch investigated cholera in Egypt, and subsequently in Calcutta. The result of these researches led him to believe that he had discovered the germ in a comma-shaped bacillus. The doctrine of contagion was much emphasised thereby, and the dread of it enhanced; the fear was so great that Southern Europe became almost demoralised, and the necessity for quarantine seemed to be a logical result.

In May, 1884, the Secretary of State for India in Council instituted a special inquiry into the subject, and sent Drs. Klein and Gibbes to study the disease in India. In March, 1885, they sent in their report, and a committee was convened at the India Office to consider it.

This committee formulated the following conclusions:—that comma-shaped bacilli are usually found in the dejecta of persons suffering from cholera, but that there are no grounds for assuming that they are the cause of the disease, that they are, in fact, but epiphenomena, thus confirming the conclusions of Lewis and Cuningham, arrived at years before.

I may here say that most important and valuable researches into Bactereology are being prosecuted with great benefit to science generally and with infinite promise of good to that of medicine in particular; but I would ask the distinguished investigators to defer generalization until the data are more numerous and more certain, especially when such important issues as those attending the discovery of the primary cause of a disease like cholera are involved.

Another theory asserts the cause of cholera, to be an

influence, the origin of which is of a dynamic nature. Goodeve says: "May it not be a mistake to consider the specific cause at all as a simple body, either generated from without, and air-wafted to a particular spot, and then multiplying itself indefinitely, or as a locally-generated agent, and spreading over certain areas? Might it not be more in accordance with facts to suppose that neither a miasm from without nor a miasm from within, exclusively contains the specific poison? Might it not be that two factors are needed, the one some air-borne material or some dynamic modification of atmospheric elements coming from without, the other some local element, neither being potent unless united? The peculiar atmosphere sweeps along hither and thither, and it is only when it meets with the other peculiar substance that the poison is generated."

Dr. Bryden, whose vast opportunities of studying the disease, give great weight to his views, maintains that cholera has a permanent abode in certain areas of India, and in other districts is renewed by invasion from this area; that the cholera miasm is earth-borne and aerially conveyed; that the disease has no power of continuous manifestation throughout the year. He says also that it can be transmitted by means of fomites, but that the aggregate of cases so transmitted, cannot produce an epidemic. He considers the presence of the cholera miasm, of a humid atmosphere and of prevailing winds to be essential to the manifestation of an epidemic, and that its length of duration is proportional to the natural degree of humidity of the district. Reappearance subsequent to invasion being—he believes—under the control of the normal meteorology of the district invaded, its date can be anticipated according to the geographical situation of the district. Outbreak, that is local manifestation, is governed by the same laws as invasion.

None of these theories satisfactorily explain all the phenomena, and the primary cause of cholera is still unknown; much, however, has been learnt of the laws and development of the disease, and as to what should be done to prevent the outbreak and spread of an epidemic.

Men whose opinions differ concerning etiology arrive at similar conclusions with regard to preventive measures. For instance: it is almost universally admitted that improvement in sanitation and purity of water-supply are efficacious means for the prevention of cholera. One, however, advocates this from the belief that a cholera germ develops in

a soil impregnated with organic matter, and that the virus enters a man's system by means of the water he drinks, while another simply believes in good sanitation and purity of water as being essential for the preservation of that normal state of health in which people are not likely to become subject to cholera. So with quarantine. Those who do not believe in the contagion of cholera naturally consider it useless; while others reject it and because it cannot be efficiently carried out, whilst it brings with it many evils without preventing the spread of the disease.

In India where a sanitary service has now been established for twenty years, the policy of the government is to reject all theories of causation and propagation as a basis for practical sanitary work; guided by very large experience they have been taught, that in dealing with cholera, theories cannot be taken as a groundwork for any useful action on the part of the State; that by improvement in the condition of localities much good can be done, but that any attempt to carry the doctrine of contagion into practice has no good results, but is productive of much harm, not only because it involves oppression, but because it vastly aggravates all the evil it is intended to prevent. In India, accordingly, all cordons, quarantine, and even isolation of the sick have been discarded, reliance being placed on sanitary measures alone, and the result proves that the confidence is not misplaced; the following statistics taken from the reports of the Army Medical Department comfirm this :—

DEATH-RATE PER 1,000 FROM CHOLERA.

English Army,	1860-69.	1870-79.	1880-83.
Bengal ...	9·24 ...	4·18 ...	2·49
Madras ...	2·56 ...	1·68 ...	0·90
Bombay ...	4·80 ...	1·53 ...	0·45

Jail Population.

1859-1867	10·67
1868-1876	3·28
1877-1883	3·61

The belief in transmission by human intercourse is still firmly held by many of the highest authorities; few consider there is any danger of communication of the disease by mere contact or personal communication, but that the danger lies in the transmission of the germ, through water or other channel, from the internal economy of one person to that of another; hence contagionists insist on what all

admit the importance of, *i.e.*, purity of drinking water. For my own part, I am unable to accept this theory as a sufficient explanation of all the facts and phenomena, and would seek the solution of the problem in causes of a wider and more general character, looking for prevention to sanitary measures, and rejecting all others—especially of a coercive or oppressive character. Nevertheless, until contagion is absolutely disproved, I think the authorities are justified in adopting measures, which avoiding all oppression and undue interference with personal liberty, take precautions against possible sources of infection, but at the same time give full effect to all known practical measures taught by the sanitary science of the present day.

The evil results of the contagion theory have been manifested not only in the rigours and hardships of quarantine, whereby great suffering, much disease and incalculable damage to commercial interests have been effected, but in the general state of panic and demoralization which has deranged and degraded society generally. The state of the South of Europe during the recent cholera was pitiable, and the measures of fumigation, isolation, and general interference with personal liberty would have been ridiculous had they not been so pernicious. The same feeling still prevails in some parts of the world, and I quote an absurd example from the *Times* of January, 22, 1886. "Two Japanese sailors died from cholera during the short journey from Kobe to Nagasaki. Their dead bodies were thrown overboard. The Japanese authorities immediately forbade fishing along the coast."—*Sanitary Record.* It would not be difficult to adduce others equally absurd.

It is satisfactory to see that a considerable modification of these proceedings took place in Southern Europe during the latest manifestations of cholera last year; whether this be due to the conviction, forced upon people by recent events, of the futility of such proceedings, or to the impression made by the British and Indian delegates at the Roman Conference, in their emphatic declarations on the subject, I do not venture to say; but we recognize the change with satisfaction, for it points to a more thorough reform still, and gives hope that in time, methods which are worthy of the dark ages will give place to those adopted here and in India.

With reference to the question of the occurrence of the disease in the lower animals, Correa observed it in animals

and birds in 1543, and there was an epidemic of so-called cholera among cats at Delhi in 1875, when 500 cats were said to have died; another at Ahmednagar in 1881, and a third at Sirur in 1883.* It has already been noticed that more than once birds have deserted cholera-affected districts. Experiments made with a view of ascertaining the inoculability of cholera have, with a few doubtful exceptions, failed to communicate the disease to animals. On the whole, I should regard their susceptibility as doubtful.

Habits and geographical distribution of Cholera.—The history of the great epidemics of cholera shews that it has extended widely over the earth's surface, yet that there are regions which have escaped. These regions, according to Hirsch and Cuningham, are:

The whole continent of Australia, except perhaps the northern part.

The Islands of the Pacific;

In Africa: the east coast south of Delagoa Bay; southern and central divisions of the interior up to the Soudan; the west coast up to the Rio Grande; the islands of St. Helena and Ascension; the Cape of Good Hope.

In North America; all the country north of the 50th parallel.

In South America; the South Polar lands, the Falkland Islands, Terra del Fuego, Patagonia, Chili.

In Europe; Iceland, the Faröe Islands, the Hebrides, the Shetland and Orkney Islands, Lapland, Russia, north of the 64th parallel

In Asia; the Northern governments of Siberia and Kamschatka; it is uncertain about Mongolia and Manchooria.†

Places in India that cholera has not visited are:—

The convict settlement on the Andaman Islands (it has occurred in men landed from Calcutta, but not as an epidemic, or but very slightly), Mussoorie, Montgomery, Mooltan, Muzzaffurgurh, Dera Ghazi Khan, Sialkot and Nowshera* (very slightly).

European towns that have hitherto escaped are:—Würtzburg, Frankfort-on-the-Main, Olmütz, Falun, Rouen, Versailles, Lyons (slight epidemic in 1854), Sedan, Cheltenham.†

In treating this section of the subject it is necessary to refer to India, so commonly regarded as the home and

* Cuningham. Cholera—What can the State do to prevent it?
† Hirsch. Handbook of Geographical and Historical Pathology.

birth-place of cholera. In certain areas the disease is endemic; these areas are:—

Lower Bengal, including the deltas of the Ganges, Brahmaputra and Mahanuddy, bounded on the West by about 85°, on the East by about 91°, on the North by 27°, on the South by about 20° 10′; the interfluvial tracts of Behar; the deltas of the Irawaddy, Salwin, Godavery, Kistna and Kaveri; the Konkan and Malabar coasts; the southern half of the North West Provinces and Oudh; the Gurgaon, Delhi and Karnal districts between the Jumna and Sutlej; the Kangra, Gurdaspur and Amritsar districts between the Beas and Ravi; the Hoshiapur and Jullundur districts between the Beas and the Sutlej;* the cities of Madras and Bombay;† the valley of the Nerbudda and Tapti rivers.‡

Hunter's investigations shew that cholera is endemic in parts of Egypt;§ in parts of Russia and elsewhere in Europe there can be little doubt that it is so, and I cannot consider the chain of evidence which would trace it to India especially as being complete. It is continually present in England, as seen by the Registrar General's returns, and probably in many other countries, though the mortality is seldom so high as to attract notice, excepting when localizing causes and epidemic influence co-operate to develop an epidemic. It is customary to regard this cholera as another form of disease—Sporadic cholera or Cholera Nostras,—but there is probably no real distinction.

The influence of climate, rainfall and prevailing winds has been carefully considered, and its exact extent, though considerable, can hardly be estimated; roughly speaking, however, heat, moisture and a stagnant atmosphere combined are conditions favourable to the diffusion of cholera. Elevation has an influence, though less positive than relative, but cholera has occurred at Simla (7084 feet) and even higher.‖

The wide-spread distribution of the disease would indicate that the nature of the soil is not a very important factor, through some writers consider that cholera is less prevalent on sandy, porous ground and in deserts, on granite, metamorphic and trap rocks, on the laterite and

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* Bellew. The History of Cholera in India.
† Aitkin. The Science and Practice of Medicine.
‡ Macnamara. A history of Asiatic cholera.
§ Hunter. Report on Cholera in Egypt in 1883.
‖ Hirsch. Handbook of Geographical and Historical Pathology.

volcanic formations, and, in England, on the primary geological formations.

Season has a decided influence, as shewn by the steady wave-like fluctuations of cholera mortality during different months, but the minimum and maximum mortality vary very much according to district. In some parts of India, such as the chief endemic area and Madras, there is a double seasonal wave; in districts where there is only one, the minimum mortality, generally speaking, occurs during the three months of November, December and January, the maximum in June, July or August.*

Outside India the disease is most active during the summer and autumn months.†

Admitting that cholera is more prevalent, active, and ever present in certain endemic areas of India, I do not consider it proved that that country is responsible for all the cholera which has overrun the world; yet such is the prevailing belief.

With regard to the spread of the disease, the theories of contagion and diffusion by human intercourse do not explain the movements of epidemics, for the history of the last fifty years shews, that though means of communication have been enormously multiplied all over India, as everywhere else, epidemics have neither increased in frequency, nor become more rapid in their progress, nor altered as to their general direction; in fact, of places that lie on the main line of traffic, many suffer little, while those that are most inaccessible often suffer most.*

Since 1877 records have been kept of the attendants on cholera patients in military and jail hospitals throughout India; it is found that 5,696 cases occupied 10,599 attendants, and that only 201 of these attendants were attacked, or 1.9 per cent.* The same immunity of attendants is shown by the statistics of the London Hospitals, in 1866, and it has been noticed that in the general hospital of Calcutta, where cholera cases are admitted indiscriminately with others, the disease has never spread.

With reference to dissemination, it has been asserted that, cholera breaking out in such an assembly as the Hurdwar Fair, on the dispersion of the pilgrims the disease has been diffused in all directions over the country; but, on careful analysis of facts, it will be found that although the pilgrims

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* Cuningham. Cholera—What can the state do to prevent it?

† Hirsch. Handbook of Geographical and Historical Pathology.

affected on the spot have died in all directions whither they have travelled, that cholera has appeared in others only in the direction in which the epidemic was moving. Further, it has been found in reported cases of importation of cholera from one station to another, that the disease had already manifested itself in the district, before the particular case which was supposed to have imported it, had arrived. Wherever thorough investigation has been possible, it has been found that explanation based on the theory of contagion fails to account for the facts.

Since the opening of the Red Sea route in 1842, and the Suez Canal in 1869, Europe has suffered no more from cholera than it did before, though traffic has increased very much; and, notwithstanding the daily communication by ships with India through the Canal and Red Sea, no instance of an epidemic being conveyed to Europe by this route has occurred.*

During epidemic prevalence cholera never attacks all the places in the area over which it is diffused, but breaks out in but few of the inhabited towns and villages, sometimes leaping over places in the direct line of its course, and returning to them later during the same epidemic. It is a remarkable fact also, that in Bengal an epidemic always moves upwards,* not necessarily along the great lines of traffic or with the rivers, but rather against them. Frequently places attacked at the same time are widely distant, and this is constantly observed in Indian epidemics, only a comparatively small proportion of villages and towns being attacked in any large area where an epidemic, however intense, prevails.

Greatest intensity is often reached at the same time over widely extending areas. In Northern India in 1879, it was manifested not only by the number of different places in which the disease showed itself, but also by the high mortality.

Cholera seems to have an affinity for certain districts,—even streets and houses,—and the same house has been known to be twice the site of the first outbreak of an epidemic; there were several in Calcutta when I was there. It is worthy of notice also that certain trades, such as the tanner's, seem to confer a prophylactic influence. Everything points to locality as the most important factor in the

* Cuningham. Cholera—What can the State do to prevent it?

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development of the disease, and to its being the most serious subject for consideration in dealing with an outbreak.

The apparent caprice and fluctuation of a cholera epidemic are shown by the following illustration from the "Report of the Sanitary Commissioner for the Hyderabad Assigned Districts for 1884":—

The mortality from cholera in these districts varies greatly in different years, *e.g.*, 87 deaths in 1884 were preceded by 27,897 in 1883, and it will be seen on comparing the returns since 1869 that a sudden fall like the one mentioned has happened two or three times, and that in only two instances (1870-71 and 1881-82) have the returns for two consecutive years been almost equal. These variations in intensity occur everywhere in India, and are not to be explained by any of the theories generally advanced; we know, however, that bad sanitation invites cholera and increases its severity, while a good sanitary state tends to keep it off, or to lessen the intensity of the epidemic. This fact was shown in the case of Spain last year, where the great cholera outbreak was undoubtedly connected with sanitary negligence.

It cannot be supposed, however, that the local or personal conditions of the provinces under consideration varied so enormously from year to year. One explanation was, that in a year of severe epidemic intensity, more susceptible people were carried off, leaving fewer to be attacked in a following year; but this view is not confirmed by statistics, and, in the absence of any certain knowledge, we must attribute the variation of mortality to variation in the intensity of the epidemic influence. To produce an outbreak of cholera, local and personal predisposing causes, as well as the epidemic influence, must be present,—the latter, however, being the the chief factor.

A province or a body of men is sometimes struck by cholera, the whole community being affected. The outbreak starts from a definite time, and the greatest mortality is compressed into a few days, generally at the very beginning. This does not result from the length of the attack, but from the virulence of the disease, which generally dies out sooner than in the typical outbreak.

I here give a few examples of such sudden outbursts.

The great epidemic which broke out among the troops of the army of Lord Hastings began on November the 7th, 1817, was in all parts of the camp on the 9th, and reached its height on the 17th. During the week in which it raged

most violently, 764 soldiers and 8000 camp followers died; the epidemic had ceased by the 22nd or 23rd of November.*

Another outbreak occurred in May, 1818, among the Nagpore subsidiary force. Between seventy and eighty cases were admitted the first day, and many were found dead and dying about the camp.*

Another instance is the great outbreak at Kurrachee in 1846. On Sunday evening, June 14th, there was a sudden change in the atmosphere, the wind veered from south-west to north-east, and a thick lurid cloud darkened the air. Later on in the evening cholera appeared in thirteen corps of the troops stationed there; it increased in violence till the 16th, when 277 cases were admitted, of which 186 died; after that date it gradually declined, 814 cases and 442 deaths having occurred between the 15th and 18th (inclusive).*

Without any premonitory symptoms, cholera appeared at Peshawur, at five o'clock on the morning of May 20th, 1867; from that day till the 23rd, the number of cases increased daily, and after that date decreased gradually, the last case being admitted to hospital on the 31st.*

A remarkably sudden outbreak occurred in an orphanage at Secundra, near Agra, on May 29th, 1867. The girls were caught in a sudden shower of rain, the elder ones being the most exposed to it. One of them was found dying at four o'clock the next morning, and subsequently 40 of them and 6 of the younger girls were attacked. Boys and girls were at once removed to different places; not one of the boys suffered. On May 30th, 16 cases were admitted; on the 31st, 15; between the 1st and 6th of June, 15; the disease then died out.

To turn to Europe. In an establishment for pauper children at Tooting, in 1849, there were crowded 1395 children, little more than 100 cubic feet of breathing space being allowed for each child. One night cholera attacked 64 of these children; 300 were attacked in all, and within a week 180 died.†

The epidemic of 1832, in Paris, commenced on the 26th of March, and increased so rapidly, that in eighteen days it had reached its climax, and had already extended to all

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* Quoted from Bryden. Cholera in the Bengal Presidency from 1817 to 1872.

† Southwood Smith. The Common Nature of Epidemics.

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the quarters of the city, and had been fatal to 7,000 people.*

The following tables show the absolute mortality of cholera, and its relative mortality, compared with certain other prevalent diseases in India; from these it will be seen, that, bad as cholera often is, it occupies by no means the highest place in the death rate.

The facts that the statistics of the death rate per 1,000 of the general population do not embrace certain provinces included in those of the absolute mortality, and

that a … fatal for … general popu… is not al… so for the … and vice … account … apparent… discrepancies … the figu…

MORTALITY FROM CHOLERA IN INDIA.†
(Including Army and Jail population.)

YEAR.	TOTAL MORTALITY.	RATE PER 1,000.
1874	18,455	·887
1875	384,858	2·434
1876	486,667	2·628
1877	637,059	3·203
1878	319,451	3·6002
1879	271,071	5·335
1880	119,170	1·0949
1881	162,266	1·745
1882	351,408	1·5435
1883	249,244	1·551

MORTALITY AMONG THE GENERAL POPULATION IN INDIA.†

YEAR.	RATE PER 1,000.			
	FEVERS.	BOWEL COMPLAINTS.	CHOLERA.	SMALL-POX.
1874	11·09	2·27	·08	1·26
1875	12·35	2·71	2·72	·78
1876	13·54	2·35	2·07	·66
1877	13·54	2·54	2·809	1·15
1878	19·80	1·959	3·53	1·49
1879	16·54	1·67	1·31	·96
1880	14·16	1·58	·367	·45
1881	14·82	1·70	·78	·37
1882	13·95	1·83	1·44	·71
1883	14·62	1·99	1·96	1·13

* Baly and Gull. Reports on Epidemic Cholera.

† Reports of the Sanitary Commissioner with the Government of India.

Before leaving this subject, it is necessary to refer to outbreaks of cholera on board ship. Cholera has frequently broken out in vessels in the harbours of affected ports, but has disappeared soon after the ship has gone to sea. On the other hand, in passenger, emigrant and troop-ships, it has made and makes its appearance from time to time, within certain periods after leaving the port,—these periods varying from two or three days to as many weeks. But, as the people on board have all been exposed to the influence of cholera before they left, we must assume that cholera was latent in them when they left.

In some cases, where the port of embarkation was not affected though the passengers came from a cholera affected district, and the disease spread to the crew, it is to be remembered, that the ship started from a country in which the epidemic influence was present, though not ostensibly in the port of embarkation.

This ship-cholera seems to give some support to the doctrine of contagion, but the truth most probably will be found to lie in the fact that the individuals attacked were cholerised before they left the country, and that insanitary local causes on board the ship developed that which was dormant in the individuals.

Dr. Sutherland, with reference to this subject, writes :—"The ship or the men must have been in a cholera locality. The men are the chief agents. They become cholerised, so to speak, and whether the disease lies dormant or shows itself, depends on other conditions being superadded. It would be another thing if cases such as these introduced an epidemic into a perfectly uncholerised country. But this has never happened; the *aura* must be there before the ships. We cannot tell yet what cholerisation is. We are seeking to know. But we do know that it is set up indigenously and without external importation."

He adds :—1. "A ship lying in an epidemic port may become part of the epidemic port after it has sailed, provided there be men on board who have also been in the locality. 2. A ship sailing on the free open sea may encounter a travelling epidemic and be struck thereby. This has happened in the Bay of Bengal, in the face of the Monsoon. 3. An epidemic may outstrip a steam ship, as happened at Malta, in 1865. 4. No cholera-struck ship ever landed an epidemic. 5. What is called the incubation period of cholera is not fixed but variable, and may require nothing but change of temperature to develop it."

Precautionary measures, general and special, against cholera.—Up to the present date the belief is maintained by foreign powers that epidemic diseases, and among them especially cholera, can be arrested in their progress and debarred from entering into a country by quarantine. This, as its name implies, and as you are probably aware, originally meant seclusion and isolation for a period of forty days, of persons either affected by a disease, or coming from a locality where it prevailed. Quarantine is based upon the assumption that the disease is communicable from person to person, either by means of the individual himself or of his effects. This, however, has been modified considerably in its application of late years, and the period of isolation has been much diminished, even by those who hold the doctrine of contagion.

It is unnecessary to describe minutely the evils that resulted from this grave interference with personal liberty; suffice it to say that they consisted of discomforts and horrors arising from the accumulation of people in Lazarettes, whereby great inconvenience and personal suffering were inflicted, with hindrance to commerce and the creation of foci of intensified disease, forming an accumulation of evils much greater than that they were intended to avert.

Still, could it be shown that by such measures, the propagation and diffusion of disease from nation to nation can be averted, their adoption, under proper management, and with precautions as to the personal safety and comfort of those concerned, would be justified as the minor evil. But, if it be true that the diffusion of epidemic disease is dependent in a great measure on atmospheric or general causes, apart from contagion, then the futility of quarantine is obvious.

The British and Indian Governments, basing their measures for prevention and protection on well ascertained facts alone, and not upon theories of etiology, have discontinued all quarantine measures, whether by land or sea, relying upon sanitation, combined with medical inspection, as the only and sufficient means of safety.

The British Government, represented by its Local Board, recognising the truly contagious nature of some diseases and its probability in others, has adopted measures of inspection and isolation of the sick, together with disinfection, and purification of ships, effects and persons, insisting at the same time on all that conduces to the

establishment of healthy conditions of living, but avoiding all undue interference with personal liberty. The following is an epitome of their measures as regards cholera :—

Ships known or suspected to have cholera on board, are to be detained by the Custom House Officers, until the Medical Officer of Health shall have inspected them.

Those on board suffering from cholera are, if possible, to be moved to a hospital, but if they remain on board they are to be isolated, and all that comes from them disinfected.

Those not suffering from cholera, but coming from an affected ship, are to be allowed to proceed to their destination, notice being given to the Health Officer of the district to which they go.

The ship itself and the effects of any on board, who have suffered from cholera, are to be disinfected and no further detention is to be imposed.

In India all quarantine, cordons and interference with personal liberty, including isolation of the sick, have been discarded as practically useless, attention being concentrated upon sanitary measures as the sole means of preventing the propagation and diffusion of the disease, as will be seen from the following summary of regulations for the army, which, as far as possible, are applied to the population generally.

In anticipation of an outbreak, personal cleanliness is especially enjoined, the utmost attention is to be given to the sanitary condition of the station, overcrowding is to be avoided and great care to be taken in watching and checking premonitory symptoms.

On the appearance of cholera, bodies of men are to be *at once removed from the affected locality ;* great attention is to be paid to the purity of the water supply, and to the nature of the camping ground, and all dejecta are to be buried in trenches dug for the purpose.

Purification and fumigation are to be resorted to, both for the room or building in which any case of cholera has occurred, and for the effects of the sufferers.

Temporary buildings are to be erected as hospitals, but, in the case of the general population, removal of the sick from their homes is not enforced. It should be clearly pointed out that no danger is incurred by attending on the sick.

With reference to the futility of quarantine, Dr. Southwood Smith says, "the object of quarantine is to prevent

the introduction of epidemic disease from one country into another," and the whole machinery of it is based on the assumption that by an absolute interdiction of communication with the sick, or infected articles, the introduction of epidemic diseases into a country can be prevented.

This assumption however, overlooks the presence of an "epidemic atmosphere," without which it is now generally admitted that no disease will spread epidemically. "Allowing therefore to contagion all the influence which anyone supposes it to possess, and to quarantine all the control which it claims," there remains this primary and essential condition which it cannot reach.

Experience shews that "the influence of an epidemic atmosphere may exist over thousands of square miles, and yet affect only particular localities." The cases of cholera which have occurred in widely distant parts of England and Scotland, and notably in India, mark the presence of this influence; yet cholera has fixed itself and prevailed as an epidemic only in comparatively few places. Why has it so localized itself? Probably because it has there found certain local or personal conditions, or both. It follows that we should make diligent search for all localizing circumstances and remove them, "so as to render the locality untenantable for the epidemic." Quarantine however, leaves all these localizing conditions "untouched and unthought of."

"The question of contagion has no necessary connection with that of quarantine." The real question is, can it prevent the extension of epidemic diseases, whether contagious or not? "If it can it is valuable beyond price; if it cannot, it is a barbarous encumbrance, interrupting commerce, obstructing international intercourse, periling life and wasting public money." "Whether it can accomplish its object or not is a mere question of evidence," and everything in India and Britain affirms that it cannot do so.

With regard to the bearing of quarantine on the question of cholera, Professor Caldwell of America says: "Cholera, though a fatal scourge to the world, will, through the wise, beneficent dispensation under which we live, be productive of consequences favourable alike to science and humanity. Besides being instrumental in throwing much light on the practice of physic, it will prove highly influential in extinguishing the belief in pestilential contagion, and bringing into disrepute the quarantine establishments that have hitherto existed."

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Measures of prevention and quarantine have been the subject of many international conferences; the following is a brief summary of the conclusions of those held at Constantinople in 1866, Vienna in 1874, and Rome in 1885:—

The theories on which the measures recommended by these conferences are grounded have undergone little change since the conference at Constantinople in 1866; the basis on which all the conclusions with regard to preventive measures are built up is still, as it was then, the theory of contagion.

Quarantine has, however, gradually been reduced from ten days imposed at the Constantinople conference, to seven days at Vienna, and to five days suggested at Rome, and even the five days are not to be exacted unless the ship has had cholera on board, or has been gravely suspected, after leaving port. But great stress is still laid on quarantine in the Red Sea, as though that were the channel by which cholera entered Europe, of which there is really no evidence.

Great modifications were suggested at Rome with regard to pilgrim traffic to Mecca, 10 days' detention in the Red Sea being reduced to 5, and 24 hours only being imposed on ships with a clean bill of health.

Land Quarantine was declared useless at the Vienna Conference, and both that and cordons were abolished at the Roman Conference last year, on the ground that they were impracticable.

It will be observed, that though the idea of contagion still prevails, it has undergone great modifications, suggesting the hope that the time may not be very far distant when reliance will no longer be placed on such barbarous institutions as quarantine, but upon sanitary measures which alone offer any guarantee for protection.

The question arises, what does it behove each individual of the community to do, as regards himself, his household, his village, town, and country, when cholera menaces, or has actually made its appearance?

Attention should be directed to careful living, careful clothing, and moderation in habits and diet. Avoid depressing influences, fear, over-fatigue, chills, violent alternations of temperature, aperient medicines, especially those of a saline nature, indigestible food, impure water, unripe or over-ripe fruit, and be careful to observe and promptly check any tendency to diarrhœa.

Pay due attention to ventilation, to perfect drainage, to purity of water-supply, to prevention of overcrowding, using all your personal influence to secure this throughout your village or town. Do not be afraid to attend upon the sick, for you will incur no danger thereby. Disinfection of excreta, effects, houses and rooms should be practised.

Protest against quarantine and all coercive measures which divert attention from the true sources of safety, summed up in the expression "complete sanitation."

There is good reason to believe that the measures recommended by our Government, if they are carried out by individuals and municipalities, are such as may imbue us with a feeling of confidence, that in the event of cholera appearing in this country, we shall be protected against any intensity of prevalence. The more we can perfect the measures now in force,—and you can do much towards this, for insanitary houses are still far too numerous everywhere —the more thoroughly we give them our individual and collective support, moral or material, the more complete we may anticipate, will be our immunity from the disease.

Experience on the Continent, during the recent epidemic, serves to show how futile coercive measures have been and must be, while the examples of Marseilles, Toulon, Valencia, Palermo, Naples, whose notoriously insanitary conditions have paid their natural penalty, will be, we may trust, a salutary warning as to how cholera may be intensified by local causes, and will give a lesson which, we hope, will not be disregarded.

We read in the *Times* of Monday, February the 22nd, that a most important memorial to the Lieutenant-Governor of Bengal, concerning sanitation is now before the Government of Bengal. This memorial states that since 1881, cholera has swept away more than 20,000 people in Calcutta and its suburbs; that in some suburban wards the death-rate has stood at 70 in the 1,000; that during the decade of 1875 to 1884, out of a population of 257,000 in the suburbs, no fewer than half have perished.

There is not the least doubt that the laws of sanitary science are thoroughly well understood in this country, and that the enactments of the Government would be most effective if properly carried out, but no Government can force good sanitation upon towns, villages, or houses, without the co-operation and hearty support of the resi-

dents, and all their measures will be found useless, unless backed up by the personal efforts and exertions of individuals. Experience shows us that in the present day the best houses are often most defective, and that local causes of disease, which might easily be removed, abound. Why spend £50 on hospitals for cholera, when £5 laid out on sanitary measures might obviate their necessity?

I do not wish to frighten you, but cholera is in Europe, and may appear wherever it can find a fitting nidus, that is, the presence of bad local conditions, and then all the quarantine and inspection in the world will not keep it out; that such bad local conditions in towns, streets and houses, are still the rule rather than the exception, is proved by the reports of the Sanitary Associations and of sanitary engineers who deal with these matters in localities where Government officials can exercise no interference. I regard this as a great sanitary defect of the present day, and I urge you to see to it thoroughly; for upon this may depend whether a pestilence which has already invaded Europe and is threatening us, shall find footing, or shall leave us unscathed.

The measures are simple enough if only the public can be brought to believe in the unseen but easily removable dangers within, around and beneath their houses.

I will conclude by quoting from the writings of Drs. Southwood Smith and Ferguson, which I strongly recommend to your attention.

Dr. Ferguson, speaking of epidemics generally, says:—"Places, not persons, comprehend the whole history, the etiology of the disease. *Places, not persons!* Let the emphatic words be dinned into the ears of the Lords of the Treasury, until they acquire the force of a creed which will save them hereafter from the absurdity of forcing quarantine. . . . . Let them further be repeated in the Schools of Medicine, until the Professors become ashamed of imbuing the minds of the young with prejudice and false belief, which, should they ever visit warmer climates, may cause them to be eminently mischievous in vexing the commerce, and deeply and injuriously agitating the public mind of whatever community may have received them."

Dr. Southwood Smith, writing on the same subject, says:—"Epidemics are under our own control; we may promote their spread, we may prevent it. We

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may secure ourselves from them. We have done so We have banished the most formidable. Those that remain are not so difficult to be conquered as those that have been vanquished. . . . . . . We see that epidemics are not made by a divine law the necessary condition of a man's existence upon earth. The boon of life is not marred with this penalty. The great laws of nature, which are God's ordinances in their regular course and appointed operations, do form and give off around us, products which are injurious to us; but He has given us senses to perceive them, and reason to devise the means of avoiding them, and epidemics arise and spread because we will not regard the one nor use the other."

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THE NATURAL HISTORY AND EPIDEMIOLOGY OF CHOLERA.*

MR. PRESIDENT AND GENTLEMEN,—It is in obedience, sir, to the behest of your predecessor that I occupy this evening the post assigned to him who, in compliance with ancient usage, is entrusted with the duty of commemorating the inauguration of the Medical Society of London by delivering an annual oration which shall deal with matter germane to the purposes for which the Society was founded.

I am as deeply impressed with a sense of the honour conferred on me in being selected for this duty, as I am with that of my inability to do it the justice it merits. I can only, at once, offer my grateful acknowledgments, and crave indulgence for the shortcomings from which I cannot hope to escape.

The subject I have selected to bring before you is "The Natural History and Epidemiology of Cholera." It appeared to me, after revolving in my mind other possible subjects for this address, that I could hardly select one of greater interest at any time, but especially now, that the dark shadow of this mysterious pestilence which has so recently loomed over Europe, has passed away, after threatening, though not invading, our own islands—thanks, no doubt in a great measure, to the protection afforded by a system of sanitary administration which, whilst preserving the general health of the people, has rendered them less susceptible to disease, the local causes of which it has contributed to diminish, if not to destroy.

I do not propose to dwell on the pathology or thera-

* Being the Annual oration of the Medical Society of London, May 7th, 1888.

peutics of cholera, but to submit to you the views which, to me at least, seem most in accordance with other facts concerning it that have been ascertained. I purpose, in short, to give a brief review of its history, habits, method of diffusion, geographical distribution, relation to climate, season, meteorological conditions and locality, its etiology, its effects on the human race, and, finally, the methods which experience has taught us are most efficient in mitigating or preventing it. This involves so much that I cannot hope to do more than indicate the most prominent points of each of these subjects; still I trust I may be able to interest the Fellows of the Society and the visitors who honour us with their presence this evening.

The subject has for many years interested me and occupied my attention; whether in the West Indies; the epidemic of 1849 in England; in India and Burmah during a varied experience of nearly a quarter of a century, or as a member of the Army Sanitary Committee for the past sixteen years, when the effects of cholera on the army as well as on the vast civil population of India have been constantly before me in the exhaustive reports which are regularly published by the Governments of India. On the ground, therefore, of personal experience, I venture to think I have some claim to make cholera the subject of this address; and, as regards fitness in respect of time and place—bearing in mind the ever-increasing tendency of cholera to enlarge its range of geographical distribution; the fact that it has so recently been present in Europe, threatening, though happily not actually invading, our own islands; that it has been the subject of international conferences, which have resulted in little else than to leave England hopelessly at issue with other powers in respect of the methods of prevention or protection; and, further, considering that as in England and India the measures adopted are totally different to those of other nations, but, as we are confident, productive of the best results—I think that no more fitting occasion for a review of the whole question could be found than the annual oration of the Medical Society of London.

My subject, therefore, is the natural history of a pestilence which exhibits many characters in common with the plagues of the middle ages; like them traversing the earth in zones, spreading in tropical, temperate and polar regions, attacking all sorts and conditions of men, uncertain and

often apparently capricious in its incidence, terrible from the rapidity and intensity with which it strikes, and from the obstinacy with which it resists all therapeutic measures, yet at the same time obedient to certain laws which regulate its incidence, diffusion and decline. Of its cause, if indeed we may assign it to any single cause, we are still ignorant, but experience and observation have made us so far familiar with its habits and the manner of its propagation and diffusion, that we are able to say how its incidence may be evaded, its course stayed, its rigour mitigated, and how it may be disarmed of much of its terror; nor are we without hope that in time to come it may, like the black death, the sweating sickness and other pests, give way before the application of the laws of hygiene, and take its place among the records of the past.

Having much in common with other epidemics, cholera possesses well-marked features of its own, but there is some reason for believing that it may have close etiological affinities with other diseases which in many respects differ from it widely in their characters.

No disease better illustrates the peculiarities of an epidemic; diffused far and wide over extensive countries, often leaping from one to the other, as it were, by bounds, or spreading rapidly among more limited communities, following a definite track, modified by climate or geographical position, dying out gradually or rapidly, to become extinct for a time, or to remain in abeyance till revivified into activity by fresh influences. On the other hand it may occur in the sporadic form, or prevail as an endemic in certain regions from which it is never absent (such as in what is called the endemic area of Bengal), whence it may spread epidemically to regions beyond.

History of Cholera.—Cholera is an ancient disease; as far back as the records of medicine extend, descriptions of it are to be found. It has been said that it first appeared as an epidemic at Jessore in Bengal in 1817, but, as I need hardly say, this is not the case. It is described by Hindoos, Chinese, Greeks and other ancient writers of the pre-Christian era; by Romans, Greeks, Arabs, and a long succession of other authors up to the present day. The Ayurveda of Susçruta describes it as Visuchika;* Chinese writers, contemporaneous with Hippocrates (5th century before Christ),

* Macpherson. "Annals of Cholera."

mention it under the name of Ho-louan; Hippocrates speaks of it as χολερη, Ionic form of χολερα, from χολη, bile, and ρόια, flux, or perhaps χολερα, the gutter of a house.* He gives descriptions of certain cases and alludes to seasonal prevalence, but does not refer to it as an epidemic. Like the Chinese he speaks of two forms, the wet and the dry. The Arabic names, "Wubba" and "Taoun," though applied to cholera, also mean pestilence, whilst "Haiza," the term used by Rhazes, Avicenna and Averrhoës,* is that in common use in India at the present day. There are various names for cholera in the East, most of them, significant of the characteristic symptoms.

Cholera is mentioned by Celsus, Aurelianus, Aretaeus of Cappadocia, Paulus Aegineta, Alexander of Tralles; by Arab writers, Rhazes, Avicenna, Averrhoes, by Ali Ben Hossein of Bokhara (1364), and Mahmud Ishah.* Bernard Gorden, John of Gaddesden, Raphael of Volterra and others mention cholera as a well-known disease in Europe, but the 13th, 14th and 15th centuries furnish little information on the subject.*

In Elliott's "History of India," a disease which may have been cholera is mentioned as occurring in 1325, but there is no other notice of it in India by Europeans before 1503.* In Europe, from early in the sixteenth century there are notices of epidemics of bowel affections and of what is called "trousse-galant," which appeared in England and France in 1545. In 1564 an epidemic of cholera occurred at Nismes; in 1643 and 1665 in Ghent, as described by Van der Heyden.* Piso says cholera was severe in Brazil in 1658;* Sydenham writes of an epidemic of cholera in London in 1669-82.† Dr. Macpherson, the learned historian of cholera, says it was present in various parts of Europe in a mild epidemic form during the eighteenth century, dying away towards the end and remaining quiet during the first years of the present century.* Outbreaks seem then to have been less severe, but the records of disease were very imperfect in those days. Sir J. Pringle describes it as prevailing in the Low Countries, about Ghent, towards the end of the eighteenth century. Dr. Short speaks of an epidemic in England in 1726. In 1722-23-24 it was in North Germany; in 1736 at Nimeguen;

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* Macpherson. "Annals of Cholera."
† Sydennam's Works, translated by Swan, page 133.

in 1742-50 in Minorca (Dr. Cleghorn); in 1751 Malouin describes an epidemic in Paris; in 1767 Dr. Short mentions cholera making havoc among men. Dr. Holmes, President of this Society, in 1777, in an address to the Society, said that it came round every year as regularly as autumn, and I might give many other references about this period and later, bringing up a continuous history of cholera in Europe to the present time.

In Asia in the sixteenth century cholera was described by the Portuguese; it ravaged the troops of the Zamorin; and an epidemic which occurred in Goa in 1543 was described by Gaspar Correa,* who says the name given by the Portuguese was Mordeshee, which continued to be used under the forms Mordshi, Morshi, Mordeshin, Mort de Chien. Garcia d'Orta and Bontius give a full account of the disease in 1629 in Goa and Java; Linschott and others also mention it. Zacutus Lusitanus speaks of its prevalence in Arabia; Baldaeus, a Dutch clergyman, refers to fatal cramps in his account of the coasts of India in 1641; Cleyer noticed cholera in China in 1669; Thevenot in Surat in 1666. Then-Rhyne refers to a remedy for it in Japan. In India it was epidemic in Mewar in 1661, in Marwar in 1681-82, in Goa in 1683-84.* In 1757 cholera occurred at Tinnevelly; in 1768-9 there was an epidemic in Pondicherry and on the coast, and in Ganjam and Calcutta in 1781. It appeared also in Java, China and the Mauritius, on the Malabar coast in 1782, as far south as Trincomalee; in Hurdwar and Central India in 1783, at Travancore in 1792, in Mewar and the Mahratta country in 1794.* After the last mentioned epidemics, notices of the disease become rarer until the great epidemic of 1817. There is abundant evidence to show that the disease has been well known and described since the very earliest periods of history, nor is there anything in this record to prove that its origin is to be traced to India alone.

The history of the distribution subsequent to this may be summarised according to Hirsch in a series called by him Pandemics.†

The first pandemic (1817-23), notably intense about Jessore in Bengal, extended over the whole of India.

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* Macpherson. "Annals of Cholera."

† Hirsch. "Handbook of Geographical and Historical Pathology."

Taking a southerly direction it appeared in Ceylon (1819), and Bourbon and the east coast of Africa (1820). Its progress in an easterly direction began with Nepaul, thence to Arracan, Burmah, Siam, the peninsula of Malacca and the East Indies (all in 1819), the Moluccas, Philippines and Chinese Empire (1820) and Japan (1822). The first place to the west of India in which cholera appeared was the east coast of Arabia (1821), then Mesopotamia, Persia, along the coast to the Euphrates and Tigris, and thence to Bagdad and Syria (all in 1821). In 1822 it extended along the Tigris to Kurdistan, thence to Syria, Palestine and Damascus (1823), and from Persia to Russia in 1822.

In the second pandemic (1826-37) cholera advanced from Bengal, along the Ganges, through the North-West Provinces, and westwards in two directions; through Cabul, Balkh and Bokhara to Orenberg, where it died out the next year; through Mesopotamia, Arabia, Syria, Palestine and by Suez to Egypt, the north coast of Africa, the east coast, Abyssinia, and some of the Soudan countries; and, in the other direction through Persia and Transcaucasia to Astrakhan, and thence over Russia. It reached Germany through Poland and Danzig; Austria, through Galicia, Turkey and Asia Minor. It appeared in Great Britain, France and the Netherlands almost at the same time (1832); the next year it was in Spain and Portugal; in 1835 it attacked the south of France and Italy, and in 1837 was in Switzerland, Austria and Germany, attacking districts in the two latter countries which had escaped before. Norway and Sweden were attacked in 1834.

Cholera appeared in Canada in 1832, extended up the St. Lawrence river and through Detroit to the United States, along the east coast and down the Ohio. From New Orleans it extended through the southern, central and western States to the shores of the Pacific (1833), Mexico and the West Indies (1833); appeared in South America (Guiana) in 1835 and Central America in 1837. Manifesting itself in an easterly direction it appeared in China and Japan.

During the third pandemic (1846-63) cholera was widely prevalent in India and had appeared in Further India, the Philippines, China and Persia before the date mentioned. From Persia it extended by its former route to Orenberg, through Siberia to the shores of the Black Sea and Constantinople; it spread over a great part of Turkey, the

Danubian Principalities, Hungary, Asia Minor, Syria and Egypt, and reached ultimately the north coast of Africa (1848-49-50). At the same time it re-appeared in India, Further India and the Malay Archipelago, and attacked Greece and Malta. Meanwhile cholera had reached European Russia through Astrakhan, extending up the Don, thence over the whole country on to Germany (1848). It was in England, the Netherlands and Belgium in 1848-49, Sweden, Austria, France and Italy in 1849 and 50. It appeared in North America in 1848, breaking out in New York and New Orleans simultaneously, extending over all the States east of the Rocky Mountains and reaching Canada in 1849 and the west coast in 1850. Panama and Mexico were attacked in 1849, then South America (New Granada), and finally the West Indies (1850-54).

There was a remission from 1850-52, and after that date, in Europe, cholera appeared in all the countries it had visited before, with the addition of Spain and Denmark. In Asia it extended over the East Indies, China and Japan, Persia, and thence to Syria. In 1853 it appeared in Algiers, in 1855 in Egypt, and subsequently Nubia and the northern coast of Africa, Somali Land, Madagascar, Mauritius (for the first time) and the Comoro Islands.

In North America it was not severe, but in Central America its area was widely extended, and in South America, Granada, Guiana, Venezuela and Brazil were invaded.

The fourth pandemic (1865-75), unlike the others, took a westward course through Arabia and Suez; Malta, the South of France, Spain and Italy being the first places attacked. From Turkey, attacked in 1865, cholera invaded the countries of the north and east of Europe, attacking them almost simultaneously, appearing in England and Belgium in 1865, and subsequently breaking out in Switzerland, the Netherlands, Norway and Sweden.

In the western hemisphere it appeared first in the West Indies (1865), and in North America in 1866. In a northerly direction it extended over the United States from New Orleans to Nova Scotia, and in a southerly direction to Central America. In South America it first appeared in Paraguay, extended down the Uruguay to Bueños Ayres and in a northerly direction to Brazil; the Argentine Republic, Bolivia and Peru were invaded.

Meanwhile cholera had reached Persia, Mesopotamia and

Syria, and in the other direction Egypt, the northern coast of Africa and Senegambia. After ravaging Somali Land, it appeared in the interior, and later on the Mozambique coast and Mauritius. In an easterly direction it attacked the East Indies, China and Japan at an early period of this pandemic.

There was a remission during the years 1869 and '70, except in Russia and Persia; the Danubian Principalities, Austria, Turkey and Prussia were again attacked, but the south and west and the Scandinavian kingdoms suffered little during the second period. Cholera appeared in New Orleans in 1873 and extended over the central plain of North America; South America was entirely free.

In Asia cholera attacked Arabia and extended to Nubia, and, following the course of the Tigris and Euphrates appeared in Mesopotamia. It broke out in Turkestan and Bokhara in 1872, and in Syria in 1875.

The pandemic which began in 1883 is so recent that I give its history in fuller detail. During 1883 cholera was restricted to Egypt. The entire mortality is not given, but up to the end of July the deaths notified to Sir G. Hunter were 12,600—the real number being probably about twice that amount. The condition of the country is described as extremely insanitary.

In 1884 cholera appeared at Toulon on June 18th, and a week afterwards at Marseilles, subsequently attacking many towns—Arles, Aix, Perpignan, &c.—in the south-east of France, where it continued till the middle or end of September.

During July it was gradually increasing in France, and appeared in Russia in a mild form at St. Petersburg and Charkoff.*

In the beginning of August cholera was in Lombardy, and by the end of the month was diffused over great part of northern Italy, raging most severely in Spezzia.

In September it appeared in Naples, and was present there in a virulent form throughout the month. In Italy during the year there were 27,030 cases and 14,299 deaths.

In October cholera was dying out in all the districts attacked, but at the beginning of the month it broke out at Yport in Normandy, was reported in other parts of

* Cuningham. "Cholera—What can the State do to prevent it?"

northern France, including Nantes, and finally appeared in Paris on November 5th, where it was active till the end of the month, there being during that time in the city 971 cases and 866 deaths.

During 1884 cholera appeared in two English ports, Cardiff being one, but failed to spread.

In 1885 cholera was prevalent in Spain from June to November, and extended over nearly the whole country. It was first reported in the provinces of Valencia and Castellon during the last week of March; by the end of May it began to diffuse, attacking Madrid in June, and spreading to the provinces of Saragossa, Toledo and Alicante. By the end of the month the mortality had reached 5,700.

During July many more provinces were involved, and the disease became much more serious in districts already attacked. The mortality for the month was not far short of 24,000.

At the beginning of August the epidemic was still increasing, but by the 7th it had reached its height, and declined steadily during September. The mortality for August was 45,000 at least; for September, rather more than 13,000. Twenty-four deaths took place within the British lines at Gibraltar.

The recorded deaths from cholera in Spain were 79,490, but 100,000 is nearer the real number. Valencia (13,400) and Saragossa (10,954) registered the greatest number of deaths.

Cholera appeared in August at Marseilles and Toulon; in November in Brittany—Brest and the immediate neighbourhood being affected.

Meanwhile, in September it had appeared in Parma, where there were 313 cases and 202 deaths; in Ferrara, Reggio, Massa, Rovigo, Genoa, Modena and Venice; during this year, however, in Italy, the disease scarcely reached the height of an epidemic. In Sicily cholera was prevalent during September and October; in the whole island there were 6,397 cases and 3,409 deaths, of which 5,535 cases and 2,959 deaths took place in the town and province of Palermo.

In Europe during 1886 cholera was prevalent in Italy, in the Austro-Hungarian Empire, and to a slight extent in Spain and France.

At the beginning of the year there were a few deaths

reported from Venice and the south of Spain, but cholera as an epidemic did not take any hold on Europe till the middle of April, when it first appeared at Brindisi, and almost at the same time in the Venetian province and to a slight extent in Brittany, while there was a recrudescence in Bilbao.

In Italy the province of Naples was slightly affected, but the greatest severity was felt in the north-east, in the provinces round Venice, as Ferrara, Padua, Bologna, Vicenza and Ravenna, and in the neighbourhood of Brindisi—Bari, Barletta, San Marco, Acquaviva suffering severely. The epidemic gradually increased in severity and in the range attacked till about the middle of August, the deaths up to that time being about 5,465. It then began to diminish in severity, but in September there were a few cases in Rome, and Sardinia was invaded. The epidemic may be said to have ceased in Italy by the middle of October, 21,000 cases and 8,650 deaths having been recorded.

The most striking feature of this epidemic was a severe outbreak at Francavilla Fontana in July, which suffered more severely than almost any other town in Italy since 1884.

In the Austro-Hungarian Empire cholera appeared at Trieste in June, and afterwards attacked places in Istria, Carniola, Dalmatia, Croatia, Bosnia and Servia. It appeared at Raab in September, and shortly afterwards at Buda-Pesth, where it had caused nearly 500 deaths by the end of November. It then began to abate, but cases were still heard of up to the very end of the year, and there was a slight outbreak in Bulgaria (Tirnova) in December.

In Spain cholera was comparatively inactive. During the first three months of the year there were cases at Tarifa, near Gibraltar, and then cholera died down again till October, when there was a recrudescence in Malaga.

In France cholera was limited to the province of Finisterre, where several deaths occurred during the first four months of the year.

In Japan it is reported that there were 50,000 cases and 35,000 deaths; the Corea is said to have been decimated.

In South America cholera appeared in Buenos Ayres in November.

In India there was no exceptional prevalence.

At the beginning of 1887 Europe was free from cholera;

in March it was reported in Sicily, but did not acquire serious proportions till July. In that month it attacked Rocella on the Calabrian coast, and increased in Sicily and on the mainland.

In Sicily its range was limited to the provinces of Palermo, Messina, Caltanesetta and Catania; its severity fluctuated slightly, but there was no distinct abatement in the island generally till the beginning of October.

In August there were cases at Malta; cholera began to increase in range in the south of Italy, and attacked Naples, Resina and other places along the Bay of Naples. It increased in range along the Bay and in the extreme south till about the middle of September, and then Naples, Reggio and their surroundings became its chief seat. From that time it ceased to increase, and by the middle of October there were no further returns from Italy.

The greatest severity of the epidemic was at Malta; it was there steadily maintained during September and October, but then the decline began, and after the middle of November there were no further returns.

The total number of deaths in Italy (including Sicily) was 2,200, in Malta 429.

In South America, the epidemic, which began in November 1886 at Buenos Ayres and Monte Video, attacked the provinces of Uruguay, the Argentine Republic and Paraguay, and in the west Chili (for the first time), where it was limited to Santiago. By the middle of May it had ceased as an epidemic, but Santiago was again attacked in the middle of November, and Valparaiso became infected.

In India there was a severe epidemic in the north-west, and 70,000 deaths are reported in the North-West Provinces during June and July=1 per cent. In Peshawar city there were 280 deaths during the month ending in the middle of August.

From this period cholera seems to have been dormant in Europe. Whether there may be a recrudescence in the spring, time will shew.

Cholera has visited our islands several times as an epidemic, with the following results:—

Date.	Deaths.
1831-32	52,547
1848-49	53,293
1853-54	20,057

Date.		Deaths.
1859	(In an epidemic form cholera was limited to Wick in Caithness, Glass Houghton, near Pontefract, and Netley)	
1866	... ...	14,378*

Geographical Distribution, Habits, Conditions, and Epidemic Movement.—The foregoing account of its movements shows how widely cholera has extended over the earth's surface, but there are geographical areas which have not yet felt its malign influences. In some it has never appeared; in others, its incidence has been so slight as to amount practically to exemption. These regions (according to Hirsch and Cuningham) are—

The whole of Oceania, except perhaps the north-eastern part of Australia, Tasmania, New Zealand, Fiji and the Malay Archipelago.

In Africa, the east coast south of Delagoa Bay; southern and central divisions of the interior up to the Soudan; the west coast up to the Rio Grande; Ascension.

In North America, all the country north of the fiftieth parallel; in the West Indies, Martinique.

In South America, the South Polar Lands, the Falkland Islands, Terra del Fuego, Patagonia.

In Europe, Iceland, the Faroë Islands, the Hebrides, the Shetland and Orkney Islands, Lapland, Russia north of the 64th parallel.

In Asia, the northern governments of Siberia and Kamschatka; it is uncertain about Mongolia and Manchooria.†

In India cholera has either not visited, or but very slightly;—

The Andaman Islands, Mussoorie, Montgomery, Mooltan, Muzzafargurh, Dera Ghazi Khan, Sialkot and Nowshera‡

European towns that have hitherto practically escaped are:—

Wurtzburg, Frankfort-on-Main, Olmutz, Falun, Rouen, Versailles, Lyons, Sedan, Cheltenham.

On the other hand there are places from which cholera is never absent, and these endemic areas (according to

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* *Pall Mall Gazette*, extra, August 8th, 1883; Macnamara, "History of Asiatic Cholera"; Lawson, "Lecture on Cholera."

† Hirsch. "Handbook of Geographical and Historical Pathology."

‡ Cuningham. "Cholera—What can the State do to prevent it?"

Corre*) comprise India, Indo-China and perhaps a part of the islands of the Malay Archipelago, a vast assemblage of countries to which one might give the name of Indo-Malayan, and which corresponds to one of the hottest and dampest zones of the world ; its limits would be on one hand the tropic of cancer and the 10th degree of south latitude ; on the other hand the 65th and 125th degrees of east longitude.

In India itself, which is regarded by many as the sole birth-place and home of cholera, it is not by any means confined to Lower Bengal and the Delta of the Ganges as is sometimes stated, but is endemic in several other and widely-distributed areas; the deltas of the Brahmaputra and Mahanuddy; the interfluvial tracts of Behar; the deltas of the Irawaddy, Salwin, Godavery, Kistna and Cavery; the Konkan and Malabar coasts; the southern half of the North West Provinces and Oudh ; the Gurgaon, Delhi and Karnal districts between the Jumna and Sutlej ; the Kangra, Gurdaspur and Amritsar districts between the Beas and Ravi; the Hoshiapur and Jullundur districts, between the Beas and the Sutlej ;† the cities of Madras and Bombay,‡ the valley of the Nerbudda and Tapti rivers.§

Hunter's investigations show that cholera is endemic in Egypt ;¶ in parts of Russia there can be little doubt that it is so. It is continually present in England, as seen by the Registrar-General's returns, and probably in many other countries, though the mortality is seldom so high as to attract notice, except when localizing causes and epidemic influence co-operate to develop an epidemic.

Cholera then occurs in the sporadic, endemic or epidemic form ; in the former it may appear anywhere ; it is endemic in Bengal and other localities, whilst under certain conditions it rages from time to time over various parts of the world, like fever, plague, dengue, small-pox and others, including the great epidemics of the middle ages, some of which are now all but, if not quite, extinct.

The term epidemic influence is, I fear, but an expression of ignorance ; we understand it to mean those causes

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* Corre. "Traité Clinique des Maladies des Pays Chauds."
† Bellew. "The History of Cholera in Egypt."
‡ Aitkin. "The Science and Practice of Medicine."
§ Macnamara. "A History of Asiatic Cholera."
¶ Hunter. "Report on Cholera in Egypt, 1883."

external to the individual or the locality, whether of atmospheric or telluric origin, by which disease is diffused generally. Dunglison called it the epidemic constitution; Chevers says he believes "that the essentials to its occurrence (*i.e.*, epidemic cholera) are an atmospheric or telluric condition due, it may be to some undetected abnormality in the air or in the earth—electric, volcanic, or other—or to the presence of some undetected microzyme or germ which predisposes those who are within the area of its occupation to cholera.*

Leon Colin describes it as "a something isolated, impersonal, detached from the disease itself, the epidemic genius (constitution, influence), a certain creative force of the different epidemics, compelling, directing, extinguishing them."

Dr. Lawson speaks of pandemic waves in relation to the operation of this influence over the earth's surface in certain directions of a definite character, these directions being northwards. From further observation he concludes that the character of the waves is telluric (magnetic) rather than aerial; that they correspond for fever and cholera with this difference, that the minimum curve of one coincides with the maximum of the other.† He further remarks, "It may be said we do not know the intricate nature of gravitation, but we recognise its existence, and have become acquainted with the conditions under which it operates."‡ So it is with regard to epidemic influence.

Dr. Austin Flint says, "the morbific agents must be transported through the atmosphere or brought in some way from situations more or less distant. The causes of epidemic disease are migratory. In some instances they traverse almost every portion of the habitable globe. This is true of epidemic bronchitis or influenza, as of epidemic cholera. It is altogether improbable that the special causes in these and other epidemics originate in the different sections of country over which their prevalence extends."¶ Dr. Flint clearly thinks that the epidemic influence is an entity of some minutely particulate form, though he does not say what.

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* Chevers. "Cholera Asiatica Maligna."

† Lawson. "Pandemic Waves."

‡ Lawson. "The Sanitary Lessons of Indian Epidemics."—*Medical Times and Gazette*, August 4th, 1883.

¶ Flint's "Practice of Medicine."

Aitkin says "there must be some distempered condition of the circumstances around us—some secret power that is operating injuriously upon our system—and to this we give the name of *epidemic influence or constitution* which is believed to predispose towards the receptivity of specific disease poisons."*

These definitions, however, help us but little. The fact is we do not know the real nature of epidemic influence; we only know that there is a potent factor in the diffusion of disease, whether it be a dynamic agency, an altered constitution of the atmosphere, or a widely diffused miasm of particulate form spreading far and wide over the earth's surface, as did the volcanic dust from Kratakoa, which but recently girdled the earth. It may depend on certain states of the atmosphere, deficiency or excess of electrical or magnetic tension, different degrees of moisture, of ozone, or other modification of its physical properties; something propagated in aerial or telluric currents, recurring at intervals, co-operating with local and personal causes, and conferring on the disease its quality of epidemicity. In some cases, perhaps, not only acting as the propagating agent, but as the cause itself.

Mr. Glaisher took the first steps in bringing to notice meteorology in its relation to epidemics, by his observations during three cholera epidemics in this country. This department of science is progressing, and data are likely to be furnished by well-organized meteorological establishments both at home and in India. We know but little, after all, of what goes on around us, or of effects produced by modifications of cosmical conditions. Whatever this influence may be, epidemic prevalence does not take place without it. This is so not only in regard to cholera, influenza, dengue and other fevers, where contagion may be questionable, but in the most contagious diseases, such as smallpox and scarlatina, for it is tolerably certain that whatever part contagion may play in etiology, it is of small importance relatively in diffusing disease.

Variation in the atmospheric pressure or moisture, extraordinary stillness of the atmosphere, deficiency in the tension of positive electricity, absence of ozone, fogs, blights, and low forms of life in the air, have all been regarded as predisposing causes. Attention has been

* Aitkin. "The Science and Practice of Medicine."

called more than once to the disappearance of birds from cholera-affected districts at the outset of an outbreak. The dreadful visitation of cholera at Kurachee in 1846, was preceded by days of intense stagnation of atmosphere, and other outbreaks have been preceded or attended by similar phenomena.

It is believed by some that local causes, in addition to certain atmospheric conditions, may determine autogenetic changes in the body which engender disease, and that the existence of a specific primary cause is not always necessary. The general opinion, however, is that an external primary cause, a distinct entity is required; in the case of cholera this is the so-called germ, said to be capable, under favouring conditions, of multiplying to any extent. The advocates of this theory have been energetic in their researches for it among micro-organisms, and have thought that they discovered it in a bacillus. A singular expression of this creed, therapeutically, was witnessed recently in Spain in inoculation for the prevention of cholera; the results, I believe, have not been satisfactory.

There are certain erroneous notions about cholera; *e.g.*, one gives that name to the disease in its fully developed condition alone; but the fact is, that it presents many phases, varying in gravity from simple malaise to collapse, and the coma of the worst forms of fever. Sporadic cholera, or cholera nostras, as it is called, when it occurs in this country, is regarded as a different disease from Asiatic cholera, or cholera maligna; but the cholera of our country is undistinguishable at certain stages from that of India. I believe that the difference in intensity or epidemic prevalence, depends on climate, locality, and the unknown conditions already alluded to. I saw as malignant a case of Algide cholera in the Lambeth Infirmary three years ago, as I have ever seen in Calcutta.

On July 31st, 1884, at the Lambeth Infirmary, I saw a case of cholera with Dr. Lloyd. The man had been an English soldier, formerly in India, ætat thirty-four, well built, but rather slight, an inmate of the workhouse. He was attacked on the night of the 29th of July, with vomiting and purging. He had not been away from the workhouse, and the taskmaster said he had done nothing, nor could he have eaten anything unusual. I found him at 1 p.m., on the 31st, with husky voice, leaden hue of face and hands, corrugated fingers, cramps in the legs, sighing,

eyes half opened, dull, all the symptoms of collapse of cholera, tongue coated and cold, body cold and clammy, temperature 96°; no urine since admission on the 30th, when he was vomiting and purging frequently; stools were rice-water with flakes; some of the vomit had been kept, it was clear like rice-water, with a sediment like bran. The pulse was faint and quick, the skin not so cold, it is said, as it had been, and the vomiting and purging had ceased for some hours; there was great thirst. Dr. Lloyd's notes of the case are given in a note. No better marked case of cholera than this one could have been seen in Calcutta.

On July 29th, 1884, William Jackson, ætat thirty-five, a porter, who had been an inmate of the Lambeth Workhouse for six weeks previously, and had not gone out of the building during that period, was seized about 3 a.m. with vomiting and purging, accompanied with severe cramp in the legs and abdomen.

About 7.30 was transferred to the adjacent Infirmary, and I found him in a state of collapse: surface very cold and clammy, skin over chest and legs blue, voice (naturally strong) reduced to a whisper, pulse almost imperceptible and very rapid, face pinched, skin over hands wrinkled, and complaining of cramps in abdomen and legs, and intense thirst; feels sick, tongue and breath cold. Temperature 97.

Has been purged about three times within an hour after admission, and about 6 p.m. vomited twice a quantity of dark fluid: no urine.

July 30th, 10 a.m.—Vomited twice during the night, no purging. Temperature 97.4.

6 p.m.—Has vomited several times, purged frequently, very offensive stools, with light coloured flakes; great thirst and restlessness. Temperature 97.6. No urine.

July 31st, 10 a.m.—Quiet night, no vomiting or purging. Temperature 96, no urine passed, thirst not quite so intense.

6 p.m.—Profuse sweating, delirium, no vomiting, purging, or urine Temperature 96.7.

August 1st, 7 a.m.—No purging, vomiting, or urine. Temperature 97.6.

9 a.m.—Temperature 98, thirst not so intense; sudden change took place about 4 p.m., and death ensued at 6 p.m.

The treatment consisted in giving small pieces of ice to suck, and the administration of warm milk and brandy, and an aromatic mixture with opium to soothe the pain.

Post mortem August 4th, 1884.

Previous History.—The patient had been an inmate of the Lambeth Workhouse since June 24th, 1884, and had not left the building even for an hour during that time. He occupied a ward, in which the other occupants had also been for over a month, and the closest examination failed to detect any of them having been anywhere near the docks, or any possible source of infection. He had been a soldier, and had served in India, where he had suffered from dysentery, but since his return to England, several years ago, had enjoyed good health, and whilst in the workhouse had never required medical treatment, or in any way come under the notice of the medical officer.

Subsequent History.—Two other cases of severe diarrhœa, terminating favourably, broke out in the workhouse, but not from the ward where the deceased came from, and for some time before and after this case of cholera, there appeared to be what usually arises every summer: a number of cases of ordinary diarrhœa, which are successfully treated without removal to the Infirmary.

"There is no such thing," says Dr. Hutchinson, of the Bengal Medical Service, "as Asiatic cholera, if we mean by Asiatic that the disease is prevalent in India alone, or any given part of the eastern continent. British cholera, Asiatic cholera, Damietta cholera, are all essentially the same disease, though it may be differing in degree and virulence;" and he remarks that cases of cholera appear every year in England in the Registrar General's returns, which under conditions which appear from time to time would produce an epidemic, as is the case, only more frequently, and with more activity in India, China, Egypt, and elsewhere.

Hutchinson also says that the law under which cholera originates, disseminates and declines is as rigid as any known law, and shows that in 105 outbreaks among European troops in India, and in jails, it was found that the percentage of deaths, which had reached eighty per cent. in the first fourteen days, rapidly diminished. He further remarks that "while three to five days represent the period of incubation of a typical invading cholera, fourteen days mark the limit of an advance of a typical epidemic. This is true of epidemic cholera wherever it appears, whether in Europe or Asia, whether in a city, amongst troops, or in a jail,"* and adds that the period of incubation with regard to individuals is forty-eight hours, deduced from certain well-known cases; but this, I think, is not to be relied on; it may be longer or shorter.

The suddenness and virulence of certain outbreaks are remarkable, and point to some factor apart from contagion or local insanitary conditions. I append the case of Kurrachee, and one or two others that illustrate this:

At Kurrachee, in 1846, on Sunday evening, June 14th, there was a sudden change in the atmosphere, the wind veered from south-west to north-east, and a thick lurid cloud darkened the air. Later on in the evening cholera appeared in thirteen corps of the troops stationed there; it increased in violence till the 16th, when 297 cases were

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* Hutchinson, "Cholera, its Cause and Mode of Dissemination."

admitted, of which 186 died, many with frightful rapidity; after that date it gradually declined, 814 cases and 442 deaths having occurred between the 15th and 18th inclusive.*

"While proceeding up the China sea, in one of the late East India Company's ships, we were suddenly attacked by cholera, men falling on deck as if struck by lightning. This continued for three days, when the visitation as suddenly ceased. As we were then using the same water that we had been drinking for three months previously, and from the time of leaving England, there could have been no contamination of the water in this instance; independently of the fact that it was contained in tanks into which extraneous matter could not possibly have entered. A precisely similar outbreak occurred on board H.M.S. 'Undaunted,' while proceeding down the China sea. As the cases continued to increase, the surgeon at the end of three days recommended the captain to change the course of the vessel. This was no sooner done than the attacks ceased, not a case occurred afterwards."†

Fabre and Chailan relate the following:—"The first case of cholera took place at Aix on June 19th, 1835; the second case did not occur till July 15th. The sixteenth and the twelfth regiments of the line, numbering 536 men, who occupied the Italian barracks, returned from their exercise at half-past seven in the morning. The soldiers at once went into the various rooms, opened the windows, took off their coats. A gust of burning wind having suddenly penetrated into the barracks, many of these men fell on to their beds as if asphyxiated. The colonel and lieutenant-colonel, acting on the advice of the surgeon-major, mounted to the second floor, and felt themselves the influence which was having such an effect on the soldiers; one of these superior officers died from cholera within twenty-four hours; the other and the surgeon-major were very ill for several days. On this very morning twenty-one men of the twelfth regiment of the line were taken to the hospital, and ten others in the after part of the day. Fourteen died in the first twenty-four hours."‡

"On June 20th, 1845, Dr. Darby wrote from Cawnpore to the Medical Board of Bengal, that during the four pre-

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* Bryden. "Cholera in the Bengal Presidency from 1817 to 1872."
† Parkin, "Are Epidemics Contagious?"
‡ *Journal d'Hygiene*, November 3rd and 17th, 1887.

ceding days the station had been struck by cholera in its most malignant form. Amongst 2,212 Europeans, there were ninety-four cases and sixty-four deaths, whilst among 16,000 natives there were only ten deaths. This epidemic only raged some days and disappeared completely."*

"In 1884 in London, in the district of Savoy, there were in a few days 537 deaths from cholera; the suddenness of the outbreak was very remarkable. The greatest local diffusion seems to have been reached on the second day, if not on the first. During two days it prevailed with the same intensity, and in the two following days it showed a diminution of fifty per cent." (Dr. Snow).†

The suddenness of an outbreak may be followed by an equally rapid decline, and the remarkable alternations, whether for better or worse, caused by changes of weather, fall of rain, depression of temperature, thunder-storms and gales of wind, are very suggestive of the influence exerted by meteorology on its progress. Sudden outbreak followed by rapid decline was well illustrated when cholera attacked our troops and ships in the Crimea. It often occurs in India. Let me give you examples, one from my own experience.

After its arrival in the Levant, the French army had suffered a great deal of sickness, but the British army had been comparatively free up to the 19th of July, when cholera appeared among our regiments in Bulgaria, and by August 19th had killed 532 men. Before appearing in our army it had attacked French ships of war in the Mediterranean and their army in Bulgaria, making great ravages among the three divisions marched into the Dobrudja and in the ships. In a day's march, sometimes within the space of a few hours, hundreds of men dropped down in the sudden agonies of cholera; out of these three divisions no less than 10,000 lay dead or struck down by sickness.

The disease appeared in the British fleet, and on the 11th and 12th of August the admirals put out from their anchorage, hoping thus to arrest its progress. It nevertheless raged with a violence rare in Europe; the "Britannia" alone lost 105 men, and the number of sick was so great as to render the usual duties impracticable. "The waywardness of the disease on board the British ships was extraordinary; it spared the officers, who partly by kindness

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* Bryden. "Cholera in the Bengal Presidency from 1817 to 1872."

† *Journal d'Hygiene*, loc. cit.

and sympathy, partly by remedies, seemed often able to fight the disease, or make the men think they did so."

Almost suddenly the cholera ceased on board ship, the survivors returned to their duties, all mention of the terrible tragedy was dropped, and in a few days from the time when cholera had been at its height, the crews were ready to embark the troops and land them in the Crimea.*

The Adjutant General had been seized by cholera on Thursday, the 21st of June; he lay in a critical state, though the medical officer entertained strong hope that the remedies would bring on the re-action desired. "Then (on Saturday), however, there broke from a summer sky, not observed to be angered before, the extraordinary thunderstorm of the 23rd of June, carrying with it great torrents of rain; and the swift atmospheric change implied by an outburst so violent extinguished at once every hope of bringing about a re-action." Estcourt died the next morning.*

In 1851 I was ordered to Dacca to take medical charge of the seventy-fourth Native Infantry, which was suffering from fever. I found the regiment—all except two companies which were away on detachment—prostrated. The regimental and other extempore hospitals were full, and there were not enough men left to carry on the routine duties of the station. The fever was malarial intermittent, remittent and typhoid. In a short time I was directed to embark all, invalids and convalescents, on board a fleet of native boats, and take them up the river for change of air. I do not remember the exact numbers, but there could not have been less than from 400 to 500 men. The boats were decked with bamboo and covered with thatch, and held from fifteen to twenty men each, and there were thirty to forty of them. Our orders were to move up the stream a few miles every day, and make fast to the bank at night. Our mode of progress when there was no wind was that of tracking. There was no cholera in the regiment or in the station, that I know of, when we started. The men were prostrated with fever, many still suffering from it, and some had splenic or other visceral complications.

We got on well for three or four days. It was the cold season; the change appeared to be doing good, and some of

* Kinglake. "Invasion of the Crimea," vol. viii.

the men seemed to brighten up, but none of them liked the move. We made fast to the banks every night, when the men, who were able to do so, landed to cook their food; they were chiefly Hindoos of high caste. The river flowed through a flat alluvial country; the banks, which were but a few feet above the river, were of sand, and the land beyond was covered with light vegetation. There were no inhabitants near at hand, and I do not remember seeing any but an occasional villager, except the few who passed connected with other boats.

We had been out a few days, moving daily up the river, when one morning it was reported that a boatman had died of cholera very rapidly in the night. That day more cases occurred, the sepoys became affected, and cholera at once invaded the whole fleet with great virulence. It was most distressing to see the poor creatures in the last tortures of cramp, vomiting and purging. We did all we could, but it was of little avail. We moved on daily, as our orders to do so were stringent, but nevertheless the disease continued. We were in the open country, on a magnificent river; the weather was fine, the temperature pleasant, and, but for our floating plague-boats, all looked bright and cheerful. The men were in agonies of despair, and entreated to be taken back to head quarters, as this, they said, was killing them. Each day produced its fresh list of cases and deaths; these soon became so numerous that the bodies were committed to the river without ceremony. It was remarkable how the days differed; on some the disease appeared to be aggravated; those who were ill got rapidly worse and died, and more fresh cases occurred, often fatal in a few hours; whilst on others the very reverse would take place.

I repeatedly urged the officer in command to return, but he could not do so without orders. After some days, when it appeared that we were going to lose all our men, we held a council and determined to return. We did so, and, be the explanation what it may, the disease ceased, and by the time we got back to Dacca it had disappeared. A large proportion of those we brought back had to be invalided. I may add that I made careful enquiry day by day if cholera had occurred anywhere in our proximity, but heard of none. It was not a cholera season. I had discussed this aspect of the question and a possible outbreak with the P.M.O. before we started.

There is room for speculation as regards the causation of the sudden outbreak of the disease, its varying intensity on different days under apparently similar circumstances, and its rapid decline and cessation as we returned. The landing in the evening and lying by the bank all night were indicated as being mainly concerned, but this was done by other boats, and we heard of no cholera in them. The state of health of the men—all suffering from malarial fever—must be borne in mind, and the question of this as a cause may fairly be entertained. The country we passed through was open and healthy; the food and water were such as Hindoos approve, and I may say the disease was not confined to the Hindoos, for there were Mahomedans among the Sepoys as well as among the boatmen. However, it is not with the view of offering any explanation of the etiology of this outbreak that I have detailed it, but merely as an example of the varying phenomena which may be met with in a cholera outbreak, and the rapidity with which it may cease.

The following is an example of the benefit of change of locality in an outbreak of cholera. In 1855 H.M. 52nd Foot were stationed at Lucknow, in a set of large buildings which had formerly been used as the royal stables. A sudden and severe outbreak of cholera took place amongst them, which, causing great mortality, produced much depression amongst the men. A committee of medical officers was assembled, which recommended immediate removal to camp outside the city on the Cawnpore Road. Notwithstanding the great heat and the consequent danger of sunstroke, of which there were indeed a few cases, the cholera entirely ceased and the regiment was restored to its original state of health.

Locality, apart from insanitary conditions, its position and physical characters are to be taken account of. Elevation has an influence, though less positive than relative, but cholera has occurred at Simla and other hill stations in India over 7,000 ft. above the sea.

The nature of the soil and the geological characters of a district have probably something to say in the localisation of cholera. Some have thought that it is less prevalent on sandy, porous ground, on granite, metamorphic and trap rocks, on laterite and volcanic formations and on the primary geological deposits, but the wide-spread distribution of the disease does not point to this as a very im-

portant factor. Cholera prevails in deltas, but that it may occur with great virulence even in a desert we know from Indian experience, and Sir Thomas Seaton's account of his march across the desert of Pat in Sind, proves not only that it may occur, but it suggests its relation to fever and insolation, a point I shall have to notice later.

On May 3rd, 1839, a convoy of over 4,000 camels, escorted by two troops of irregular cavalry, a wing of the 23rd Bombay Native Infantry, a wing of the 42nd Bengal Native Infantry, a company of one of the Shah's regiments, and a troop of irregular cavalry, started from Shikarpur to join the army in Afghanistan. There were also a number of convalescents and a multitude of camp followers. Their road lay across the desert of Pat in Sind, which begins thirty miles west of Shikarpur, and stretches to the foot of the Bolan Pass. They reached Rojhan on the borders of the desert on May 28th, after encountering many difficulties. On May 29th they started across the desert, and from the very beginning suffered severely from want of water. Deaths occurred during the 31st, but it was not till the evening of that day that cholera appeared. They were obliged to make a *detour* to search for water, and the extra fatigue added much to the sufferings caused by absence of water, by the extreme heat, which rose in the tents to 119°, by the fierce desert wind and the myriads of flies. Their route was marked by scores of men ill and dying from fever, cholera and sheer exhaustion. "Some of the sufferers were fast sinking from fever, and were delirious; others appeared to be just seized with cholera; many exhausted by thirst, and overcome with fatigue, were bitterly bewailing their sad fate." Cholera, fever and sunstroke worked great devastation, and on June 3rd the desert wind began to blow with increased violence. "Some of the men sank at once as if struck by some poisonous air, others were brought in alive, but dying fast —quite shrivelled in appearance, as if the hot wind had dried up all the juices in the body." Officers, as well as men, suffered severely. "The scene in Major L——'s tent I shall never forget; it was appalling. B——, suffering all the agonies of cholera, was the colour of lead; H—— was raving; S—— and M——, both of them speechless and helpless from utter exhaustion, appeared likewise as if struck with cholera."

The march across the desert occupied between seven

and eight days, and these sufferings continued the whole time, disease not beginning to diminish till they reached Baugh on the morning of June 6th.*

The greatest intensity of cholera incidence is not always found to be in the most populous places. "It was among the wandering tribes of the desert of Arabia, and among the scattered population of the mountainous region of the Caucasus, that cholera, on its first invasion of these countries, prevailed in its greatest intensity, and committed its greatest ravages. In Arabia, a third of the inhabitants, according to Moreau de Jonnes, perished, while in the Caucasus, 16,000 or two-thirds of the population were attacked, and 10,000 or nearly half, died. During the outbreak of cholera in Jamaica in 1850, at Kingston with a population of 40,000, not more than a sixth, or sixteen per cent. of the inhabitants were cut off. But at Falmouth, a small town, the deaths amounted to a third. In Port Maria, a still smaller town, two-thirds of the population, or 600 out of 900 perished. 'At first,' writes the Rev. T. Simpson, 'the epidemic was mild in its type, and yielded readily, in most cases, to the treatment of our medical men. But, on the 1st of December, it burst on the town like a flood, carrying off 400, nearly half the population, in the short space of ten days.' In the small towns and villages the mortality was much greater."†

Bryden says "The geographical distribution of an invading cholera is purely a phenomenon of meteorological significance. Epidemic cholera is never in any case spread *over a definite geographical area* by human intercourse alone; nor can human agency cause the boundaries of a natural province which has been occupied by cholera to be transgressed, so that a cholera *epidemic from such a source* shall appear in the province immediately adjoining and become generally diffused among its inhabitants.‡

Seasonal prevalence in India varies according to the district. Generally speaking the minimum intensity is in the winter months, while the maximum varies, falling sometimes in the summer, sometimes in the spring. In the endemic area and Madras there are two maximums, in the former in the spring and winter months, in the latter in the summer and winter months. Outside India the

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* Major-General Sir T. Seaton, K.C.B. "From Cadet to Colonel."

† Parkin. "Are Epidemics Contagious?"

‡ Bryden, "A Report on the Cholera of 1866-68."

maximum is generally in the autumn and winter months, and we have Pettenkoffer's authority for stating that in Prussia the minimum is in March and April, the maximum in September, the rise from July being rather rapid. This question, as well as many others, such as the caprice of an epidemic shewn by its passing over many places in an area attacked, and its varying intensity in different years, is as yet unexplained.

Statistics given by Dr. H. W. Bellew, C.S.I., in his "History of Cholera in India," shew that a definite and fixed relation exists between cholera prevalence, and seasonal distribution of rainfall and the condition of the soil which receives it; drought followed by irregular scanty rainfall, scanty falls followed by heavier ones, and *vice versa*, are all favourable to cholera prevalence; that intensity of rainfall phenomena and cholera activity have a marked tendency to run in three years' cycles, greatest intensity being in the first year, followed by gradual diminution; dear food or famine distress influences the severity of an epidemic. Statistics are given for the years 1862-81, and in each cycle cholera followed the course laid down—except in that of 1875-77, when instead of abating it increased;—in each year of that cycle there was drought in the previous year, followed by excessive monsoon rains, aided by famine.*

The conditions of the subsoil water, its fluctuating level and its stagnation, are no doubt concerned in the development of cholera, as beyond a doubt they are in that of fever, of which it is a potent factor; for it is certain that a water-logged subsoil and undrained ground, materially affect the public health and add to the mortality from fever, and probably also from cholera.

With regard to epidemicity in the endemic area, Cuningham says "In all parts of the country there is a most marked difference between the results of different years. In some years the disease is in abeyance, in others it is epidemic, and between these extremes there are many gradations. Even in the endemic districts, the difference between an epidemic and a non-epidemic year is very striking. In Nuddea, for example, in 1871, only 528 deaths from cholera were registered, in 1882 the number was 11,020. In Backergunge in 1871 the number was 291,

* W. H. Bellew. "History of Cholera in India."

in 1877 it was 19,177. Similar results are to be seen in the districts outside the endemic area." . . . . . .
" It is not to be supposed from the above remarks that the periods of cholera abeyance and cholera prevalence occur simultaneously all over the country. The case is rather the reverse. In a year when one province is suffering, another may be enjoying remarkable immunity. It does, however, usually happen that marked cholera abeyance or cholera prevalence is observable over large areas—areas which often include many districts. In some years, as notably in 1874, there was a marked abeyance of cholera over the greater part of India. In the endemic area and in the districts lying around this area, cholera, as a rule, occurs rather in a large number of individual cases here and there than in epidemic outbursts."*

Since 1877 records have been kept of the attendants on cholera patients in military and jail hospitals throughout India. It is found that 5,696 cases occupied 10,599 attendants, and that only 201 of these were attacked, or 1.9 per cent. The same immunity of attendants is shewn by the statistics of London Hospitals in 1866; and in the General and Medical College Hospitals of Calcutta, where cholera cases are admitted indiscriminately with others, the disease has never spread; but this, indeed, has been the experience in India generally.

With regard to the spread of cholera, theories of contagion and diffusion by human intercourse do not explain the movements of epidemics, for the history of the last fifty years shews that though means of communication have greatly multiplied in India, as everywhere else, epidemics have neither increased in frequency, progressed more rapidly, nor altered as to their general direction. In fact, of places that lie on the main line of traffic, some suffer least, while others, more inaccessible, suffer most.*

With reference to dissemination, it has been asserted that cholera breaking out in such an assembly as the Hurdwar Fair, on the dispersion of the pilgrims the disease has been diffused in all directions over the country; but, on careful analysis of facts, it will be found that although the pilgrims on the spot have died in all directions whither they have travelled, that cholera has appeared in others only in the

* " Cholera—What can the State do to prevent it?" Cunningham.

direction in which the epidemic was moving. Further, it has been found in reported cases of importation of cholera from one station to another, that the disease had already manifested itself in the district, before the particular case which was supposed to have imported it had arrived. Wherever thorough investigation has been possible, it has been found that explanation, based on the theory of contagion, fails to account for facts.

It is certain that the most frequented routes of human traffic, or the most direct lines of intercourse are not always marked by frequency or intensity of cholera, and it seems especially remarkable, if cholera be spread by human intercourse, that since the opening of the Red Sea route in 1842, and the Suez Canal in 1869, the disease should not have been conveyed to Europe by the stream of vessels which are daily sailing from Calcutta, and other cholera localities.

Cholera seems to have an affinity for certain districts—even streets and houses. I remember several houses, or groups of houses, in Calcutta, which were known to be liable to suffer from cholera, and it is so still in a marked degree, as shown by the last report of Dr. Simpson, the very able health officer of Calcutta. One side of a street may suffer, while another escapes; a small stream may divide a cholera affected district from one perfectly free. It is worthy of notice, also, that certain trades, such as the tanners, are said to confer a prophylactic influence.

During epidemic prevalence cholera never attacks all the places in the area over which it is diffused, sometimes leaping over places in the direct line of its course. and returning to them later, during the same epidemic. It is a remarkable fact also, that in Bengal an epidemic always moves upwards,* not necessarily along the great lines of traffic, or with the rivers, but rather against them. Frequently places attacked at the same time are widely distant, and this is constantly observed in Indian epidemics, only a comparatively small proportion of villages and towns being attacked in any large area where an epidemic, however intense, prevails.

The apparent caprice and fluctuation of a cholera epidemic are shown by the following extract from the "Report of the sanitary Commissioner for the the Hyderabad Assigned Districts for 1884:"—

"The mortality from cholera in these districts varies

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* Cuningham. "Cholera—What can the State do to prevent it?"

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greatly in different years, *e.g.*, 87 deaths in 1884 were preceded by 27,897 in 1883, and it will be seen on comparing the returns since 1869, that a sudden fall like the one mentioned has happened two or three times, and that in only two instances (1870-71 and 1881-82) have the returns for two consecutive years been almost equal."

The following table shews how cholera varies in its incidence from year to year, and relates to the time when I was with the Prince of Wales in India.

	Cholera deaths. 1875		Cholera deaths. 1874.
Bengal Proper and Assam	116,606	...	73,354
North West Provinces	41,106	...	6,396
Oudh	23,321	...	68
Punjab	6,246	...	78
Central Provinces	14,643	...	14
Berar...	22,465	...	2
British Burmah	761	...	960
Madras and Mysore	97,051	...	313
Bombay	47,573	...	37
Rajpootana, Hyderabad and Central India	14,649	..	4

These variations in intensity occur everywhere in India, and can hardly be explained by the theory of contagion; we know this much, however, that bad sanitation, especially impure water, invites cholera and increases its severity, while a good sanitary state tends to prevent it, or to lessen the intensity of the epidemic. This was shown in the case of Spain in 1885, where the great cholera outbreak was undoubtedly connected with sanitary negligence.

Etiology.—There is much in the symptoms and general conditions of cholera, to support the view which has been advanced by several observers, that it is only another form of fever, and that it owes its origin to analogous causes. Certainly fever and cholera frequently prevail at the same time, and have so much in common that it is difficult to differentiate between them, especially during epidemic prevalence.

In an outbreak at Umritsar in 1881, Dr. Ross says:—"Fever in the city did not appear in an epidemic form until September. It was preceded by cholera early in August of an extremely fatal type. This later on, when masked by fever, was difficult to recognise." Of another outbreak he says:—"In Kohat in 1869, an outbreak of

fever very similar to the Umritsar epidemic, followed by cholera, occurred. It was then observed that it was often impossible to differentiate them.

Dr. Chevers expresses similar views, and refers to a series of illustrative cases which show how closely cholera and malarial fever are etiologically allied. Some indeed extend the community of origin to other diseases, such as insolation, dysentery, influenza.

The following is a remarkable instance of the community of origin, if not identity of cause which occurred under my own observation, during the Burmese war in 1852. A party of European troops had been encamped for certain strategic purposes on some ground which had been recently cleared of dense jungle. They were rapidly attacked by fever and dysentery of the worst type, and, I believe, by cholera too. Many cases of fever and dysentery were sent to the Field Hospital at Rangoon under my charge. The fevers were remittent, of the most fatal type. The dysentery was equally fatal, the symptoms most severe, rapidly passing into a state of collapse, and after death the large intestine found to be gangrenous almost from end to end. There were other cases of less severity, but the intensity of the morbific agency, and its power of inducing different pathological conditions was well illustrated in the cases referred to.

The sweating sickness of Mahwar, described by Dr. Murray in 1840, was probably only another manifestation of pathological conditions originating in the same cause to which cholera may be referred, and abundant illustration of this might be advanced did time permit. The different forms in which the morbific agency, whatever it be, manifests itself are the result presumably of an evolutionary process determined by constitutional predisposition and on certain conditions of the surroundings, of which we know but little.

The type of cholera varies considerably in different epidemics; vomiting, purging, cramps, early and late appearance of collapse, consecutive fever, &c., present great difference in the modes in which they occur, whilst the fatality, also, of some epidemics is much less than that of others; there can be little doubt that these characters of an outbreak are influenced by meteorological and local causes.

Aitken says :—" It is desirable if possible to get rid of

the term *cause* as applicable to any particular disease. . . . . There is no disease I know of which acknowledges any single cause." But rather says he, "Ought it to be our business to find out the many and ever varying factors or conditions which as antecedents combine to produce disease, and while we must acknowledge the influence of many agents in aiding and abetting these factors, we must mainly look to the physiological agencies within our own bodies during life as competent to bring about many forms of disease,"* and this may be applied to the question of the causation of cholera.

Chevers says: "The discovery of the cause of cholera will probably never be vouchsafed to a man of narrow and one-sided views. I believe that nothing valid will be revealed to us, unless we grasp and correlate all facts."† We may not know the cause, but it is assumed by some, that, though we have never seen it, there is a specific organic germ, which being introduced from without, gives rise to the disease. I venture to think that even this is not yet proved.

Chevers says: "I have never seen or heard anything which, upon close investigation, shakes my firm impression that a specific poison is not contained in the stools."†

There are several theories of the causation of cholera; briefly, they are as follows:—

That it is due to a miasmatic poison, which being absorbed by the lungs or alimentary canal, produces a primary disease of the blood, where it is rapidly multiplied, and causes disturbance of vital functions; that the diffusion of the disease is effected by human agency, the specific poison being carried by the persons and effects of those who have been exposed to it.

That it is due to a specific poison or germ which passes from the bowels of one person to those of another, chiefly by water, the poison being contained in the dejecta.

A modification of this theory assumes that to produce cholera, the organic germ must be in a certain vibrionic stage of decomposition. This germ may be preserved in a dry state for years, but whether fresh or old, it undergoes rapid changes in water. Oxidisation, acids and certain degrees of temperature, it is inferred, can render it harmless.

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* Aitken. "Animal Alkaloids."
† Chevers. "Cholera Asiatica Maligna."

According to Pettenkofer, a germ is developed in a damp porous soil with fluctuating subsoil water level, impregnated with organic matter—it is, in short, earth-born. The germ must remain in the soil some time and ferment before it acquires poisonous characters; it then rises into the air as a miasm, and thence effects entry into the body by means of air, food or water. The germs further developed and multiplied are again expelled. In considering the effects of traffic on the transmission of cholera, he says: "The dejecta are not the only means of spreading cholera, and possibly in that way they are harmless." The conditions above stated, combined with personal susceptibility, must concur for the production of an epidemic.

In 1883, Professor Koch, after investigating cholera in Egypt and later in India, discovered a bacillus in the alvine discharges of cholera patients, which was announced to be the germ which caused the disease. The doctrine of contagion received thereby an impulse by which the dread of it became enhanced, and southern Europe for a time was almost demoralised by fear, whilst the old measures of coercion and quarantine threatened to be reimposed with greater severity than ever.

In May, 1884, the Secretary of State for India, at my instance, despatched a commission (Drs. Klein and Gibbs) to investigate the subject in India. In March, 1885, they submitted their report, and a committee of physicians and pathologists was convened to consider it. The following conclusion was arrived at:—that comma-shaped bacilli are usually found in the dejecta of persons suffering from cholera, but that there are no grounds for assuming that they are the cause of the disease; that they are, in fact, but epiphenomena—thus confirming the conclusions of Lewis and Cuningham, arrived at years before, after a long and careful microscopic study of the disease in India.

Aitkin in his work on "Evolution in its application to Pathology," remarks:—"Perhaps the brilliant success which has been achieved by the recent studies of disease producing organisms or other materials acting on us from without—a success not equalled in any other field of medical enquiry—has made some think too little of those changes within ourselves, which occur in such ordinary conditions of life that they may be called spontaneous, yet these are not less important in the production of diseases, and must be studied, just as in agriculture, soil

must be studied as well as the seeds."* I venture to think the above suggests the danger of too hasty generalisation, and of reasoning on insufficient data.

Whilst fully recognising the great value of these bacteriological researches and their bearing upon etiology, the full importance of which cannot yet be estimated, I demur to a microbe being accepted as the solution of such a problem as the cause of cholera.

Dr. Bryden, whose unrivalled opportunities of studying cholera in the most exhaustive manner give great weight to his opinion, maintained that cholera is due to a miasm and has a perennial abode in certain areas of India, and in other districts is renewed by invasion from these areas. That the cholera germ or miasm is earth-born and aërially conveyed, and that the disease has no power of continuous manifestation throughout the year. He thought it could be transmitted by fomites, but that the aggregate of cases so transmitted would not produce an epidemic. He thought the presence of the cholera miasm, a humid atmosphere, and certain prevailing winds essential to the production of an epidemic, and that its duration bears some relation to the humidity of the locality. Re-appearance after invasion and outbreaks are governed by the same laws as invasion.

Another theory assigns to cholera a cause independent of a specific germ. Dr. E. Goodeve says, "May it not be a mistake to consider this as a simple body either generated from without, and air-wafted to a particular spot, and then multiplying itself indefinitely, or as a locally generated agent, and spreading over certain areas? Might it not be more in accordance with facts to suppose that neither a miasm from without, nor a miasm from within exclusively contains the specific poison? Might it not be that two factors are needed, the one some air-borne material, or some *dynamic modification* of atmospheric elements coming from without; the other some local element, neither being potent unless united? The peculiar atmosphere sweeps along hither and thither, and it is only when it meets with the other peculiar substance that the poison is generated or the effect produced."†

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* Aitken. "Evolution in its application to Pathology."

† Reynold's "System of Medicine." Article on Cholera, by E. Goodeve.

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For my own part I am unable to convince myself that any of these theories satisfactorily or conclusively explain all the phenomena exhibited by a cholera epidemic, or that one view can be accepted to the absolute exclusion of all others, for there is much to support each. Whether this ultimate cause be a bacillus, a chemical molecule, or the outcome of forces surrounding us, of external influences acting on cerebro-spinal centres and producing certain perturbations of physiological processes, or perhaps developing an autogenetic poison, is a question still demanding solution, and I agree with Chevers that the cause will probably not be revealed to anyone who searches with narrowed views. There is a great tendency in these days to trace all disease to a specific exterior cause, but we must not lose sight of the possibility of poisons autogenetically developed with which the researches of Gautier, Peter, Brown, Lauder Brunton and others are making us familiar, or of altered conditions of innervation, deranged natural physiological processes of vaso-motor action caused by forces acting from without, giving rise to disease. The primary cause, *i.e.*, the factor or group of factors which cause cholera, is still unknown, but so much, however, has been learnt of its habits, that in Europe and India we have come to know that action based on any theory of contagion is as useless as it is unprofitable. As to the local conditions which foster and develop, if they do not cause cholera, the most potent and protective safeguards against them are cleanliness, pure air, pure water, good food, clothing, lodging and healthy conditions of living; and, with reference to water, as Dr. Simpson of Calcutta remarks, "A study of the distribution, progress and seasonal changes indicates that the chief factor is a want of pure water."*

Happily, however much we in England and India may happen to differ as to certain points in the etiology, we are in accord as to the principles on which preventive sanitary measures should be conducted. As regards coercive measures, such as cordons and quarantine, they are rejected as useless, bringing many evils without preventing the spread of disease.

We have been charged by other nations with maintaining these views in accordance with the commercial interests of

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* "The Progress and Distribution of Cholera Mortality in Calcutta," W. J. Simpson, M.D.(Aberd.), D.P.H., Camb.

our country, but on what grounds it is difficult to understand, for, as Chevers says, "Being quite unaware what that interest is, save that it appears to me that if I were a Bristol merchant it would not be to my interest to see that port impested with cholera. . . . . I remain absolutely unconvinced of the protective efficiency of sanitary cordons and quarantine in cutting off the approach of that which does not travel, and in arresting the propagation of that which is never propagated." *

The belief in transmission by human intercourse is still firmly held by the highest authorities; few consider that there is danger from mere contact or personal communication, but that the danger lies in the transmission of the germ through water or other channel from the bowel of one person to that of another; hence they properly insist on what others equally admit—the importance of the purity of drinking water; who do so not because it contains a germ, but because impurity tends to develop the pathological conditions which result in cholera. For my part I am unable to accept the water theory as a sufficient explanation of all cholera outbreaks, especially in those which occur where the water is beyond suspicion of cholera contamination, and my agnosticism leads me to seek the explanation in causes of a wider and more general character, though I desire to speak as one who is still waiting for further information, and who, though strongly impressed with the incommunicability of cholera by the ordinary modes of contagion, is still not prepared to assert dogmatically that under certain conditions it may not become communicable by some miasm engendered in localities such as quarantine lazarettes where disease is intensified by crowding. I hold, moreover, that until contagion in any form be entirely disproved, authorities are justified in adopting measures which, like those in force in our own country, whilst avoiding all oppressive or coercive interference with personal liberty, take reasonable precautions against possible sources of infection and give full effect to all known practical measures against the importation or diffusion of disease.

Coercive Measures and their Results.—The evil results of the contagion theory, as interpreted in other countries, have been shown not only in the rigours and hardships of quarantine, whereby great suffering and incalculable damage to commercial interests have been effected, but in the general

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* Chevers. "Cholera Asiatica Maligna."

panic and demoralisation which have degraded and deranged society generally.

The state of Southern Europe during the recent cholera was pitiable, and the measures for fumigation, isolation, and interference with personal liberty would have been ridiculous had they not been so mischievous. The following notice, extracted from a daily paper of the 27th of August, 1887 (*Scottish News*), reminds one of the state of feeling in the Middle Ages, when the Jews were victimised as the supposed originators of the plague:—

"*The Cholera in Sicily—Sanguinary Scenes.*—A letter from Palermo, published in Vienna, reveals a startling state of things in Sicily, consequent upon the reappearance of the cholera. The ignorant population attribute the outbreak of the terrible epidemic to the evil disposition of the Government. Assassination, incendiarism, and sanguinary encounters with the gendarmes and troops are reported from different parts of the island. The measures taken by the authorities since the last visitation of cholera, such as the disinfection of certain villages, suppressing unwholesome wells, and reinforcing the medical staffs, have been misconstrued and taken by the people as a sure indication that the Government wanted to send them the disease. Special precautions were taken at certain places, and shortly afterwards a case of cholera occurred at one of them, the patient being transferred to the cholera hospital recently erected. The same night a band of villagers armed to the teeth, set fire to the building, and murdered the sick man, whom they accused of being paid by the Government to spread the malady amongst them. They then repaired to the high road, and, taking up a position behind the bushes on either side, they there awaited the arrival of the gendarmes, whom the mayor had sent for when the first alarm reached him. When the gendarmes came up with the miscreants they were greeted by a deadly fusillade that cost the life of their brigadier. The aggressors fled to the neighbouring woods, where they were attacked the next day by the troops. Half of them were shot and the others taken prisoners, but not before many soldiers had fallen. At Leonforte the armed inhabitants had a formal encounter with the carabineers. Dispersed after a savage combat, the bulk of them fled to the monastery of San Vincenzo, where they barricaded themselves and underwent a regular siege. The carabineers, reinforced by infantry, burst open the doors, and forced their way into the monastery. After a desperate

resistance the besieged were overpowered, and the survivors were marched off to prison under a strong escort. A state of siege has been proclaimed in the town. Similar events have taken place at Caltagirone. Seventy-eight peasants have been arrested at Catania. The island seems to be in a complete state of revolution."

A similar feeling exists in other parts of the world. Take the following absurd instance from the *Times* of the 22nd of January, 1886: "Two Japanese sailors died from cholera during the short journey from Kobe to Nagasaki. Their bodies were thrown overboard. The Japanese authorities immediately forbade fishing all along the coast.—*Sanitary Record*."

It is satisfactory to know that a modification of coercive measures has taken place in Southern Europe during the recent manifestations of cholera. Whether this be the result of the conviction, forced upon the people by events, of the futility of such proceedings, or whether it may be in some measure the result of the emphatic declarations made against quarantine by the British and Indian delegates at the Roman conference, I cannot say; but we hail even this much as an augury of better things to come, and regard it as an indication that methods worthy of the dark ages will be discarded as they have been in Britain and India—I wish I could say in our colonies!

In Britain we have the moderate but more effective system of prevention laid down by our Local Board. In India, where a sanitary service has been organized for more than a quarter of a century, the policy of the government, taught by experience, rejects all theories of causation and propagation as a basis for sanitary work, for they have learnt that any attempt to carry the doctrine of contagion into practice has no good results, but is productive of harm, for it involves oppression, and aggravates the evils it is intended to prevent. Coercive measures have been discarded, reliance being placed on sanitary measures alone, and the results seem to be satisfactory, judging from the following statistics which are taken from the 21st and 22nd Annual Reports of the sanitary commissioner with the Government of India.

DEATH-RATE PER 1,000 FROM CHOLERA.

British Army,	1860-69.	1870-79.	1880-83.	1884.	1885.
Bengal	9.24	4.18	2.49	1.34	1.17
Madras	2.56	1.68	0.90	0.93	0.19
Bombay	4.80	1.53	0.45	4.85	6.92

Jail Population.

1859-67	10.67
1868-76	3.28
1877-83	3.61
1884	1.43
1885	3.44

The mortality of cholera is high when it has reached the condition of collapse, or consecutive fever. At the outset of an epidemic probably half or more than half of those affected die. The fatality decreases as time goes on, and this has led the inexperienced to think that they have found some more effective mode of treatment than hitherto known. This diminution in intensity and fatality as an epidemic progresses is not peculiar to cholera epidemics; it occurs in others and was observed by Defoe in regard to the plague in London, during the seventeenth century. In an outbreak of cholera at Kurachee of the first 100 admitted 79 died; of the second, 66; of the third, 50; of the fourth, 40; at a later period the mortality diminished and the cases were less severe.

The following tables show the mortality from cholera in India, during a series of years, and it will be seen that it is a trifle compared with that of fevers:—

MORTALITY FROM CHOLERA IN INDIA.*†
(Including Army and Jail population.)

YEAR.	TOTAL MORTALITY.	RATE PER 1,000.
1876	486,704	2·47
1877	637,096	3·49
1878	319,503	1·704
1879	271,094	1·45
1880	119,182	·63
1881	162,290	·85
1882	351,422	1·76
1883	249,248	1·24
1884	287,926	1·45
1885	386,546	1·95

* Excluding Calcutta.
† Reports of the Sanitary Commissioner with the Government of India.

MORTALITY AMONG THE GENERAL POPULATION IN INDIA.†

YEAR.	RATE PER 1,000.			
	FEVERS.	BOWEL COMPLAINTS.	CHOLERA.	SMALL-POX.
1876	11·49	1·52	2·47	·53
1877	13·85	2·15	3·49	1·009
1878	17·35	2·22	1·703	1·64
1879	19·04	1·35	1·43	1·04
1880	14·68	1·25	·63	·37
1881	16·83	1·37	·85	·39
1882	15·75	1·41	1·76	·42
1883	14·37	1·306	1·24	1·16
1884	16·72	1·39	1·45	1·68
1885	17·18	1·48	1·95	·408

It may be well here to refer to cholera on board ship. It has frequently broken out in vessels in the harbours of affected ports, but has disappeared soon after the ship has gone to sea; in passenger, emigrant and troopships, it makes its appearance from time to time, within certain periods after leaving the port,—varying from two or three days to as many weeks. But, as the people on board have been exposed to the influence of cholera before they left, we may assume that cholera was latent in them when they left.

In some cases, where the port of embarkation was not affected, though the passengers came from a cholera-affected district, and the disease attacked the crew also, it is to be remembered that the ship started from a country in which the epidemic influence was present, though not ostensibly so in the port of embarkation.

Ship-cholera seems to give some support to the doctrine of contagion, but the truth most probably will be found to lie in the fact that the individuals attacked were cholerised before they left the country, and that insanitary local causes on board the ship developed that which was dormant in the

† Reports of the Sanitary Commissioner with the Government of India.

individuals, or that the ship passed through a zone of epidemic influence.

Dr. Sutherland writes :—" The ship or the men must have been in a cholera locality. The men become cholerised, so to speak, and whether the disease lies dormant or shows itself, depends on other conditions being superadded. It would be another thing if cases such as these introduced an epidemic into a perfectly uncholerised country. But this has never happened ; the *aura* must be there before the ships. We cannot tell yet what cholerisation is. We are seeking to know. But we do know that it is set up indigenously and without external importation."

He adds :—" 1. A ship lying in an epidemic port may become part of the epidemic port after it has sailed, provided there be men on board who have also been in the locality. 2. A ship sailing on the free open sea may encounter a travelling epidemic and be struck thereby. This has happened in the Bay of Bengal and elsewhere, in the face of the Monsoon." For example, in November 1848, two ships, the " Swanton " and the " New York," were struck with cholera in the Atlantic Ocean, the former twenty-six days after leaving port, the latter sixteen days. Both these vessels sailed from Havre at a time when cholera was prevalent in Germany, but had not reached the west of France. " 3. An epidemic may outstrip a steam ship, as happened at Malta in 1865. 4. No cholera-struck ship ever landed an epidemic. 5. What is called the incubation period of cholera is not fixed but variable, and may require nothing but change of temperature to develop it."

Precautionary measures, general and special, against cholera.—The belief is maintained by foreign powers that epidemic diseases, and especially cholera, can be arrested in their progress and debarred from entering into a country by quarantine. This once meant seclusion and isolation for a period of forty days, of persons either affected by disease, or coming from a locality where it prevailed, and is based upon the assumption that the disease is communicable from person to person, either by means of the individual himself, or of his effects. Of late years, the period of isolation has been diminished, even by those who hold the doctrine of contagion.

It is needlees to dilate minutely on the evils that resulted from this grave interference with personal liberty;

suffice it to say that they comprised discomforts and horrors arising from the accumulation of people in lazarettes, whereby great inconvenience and personal suffering were inflicted, with hindrance to commerce and the creation of foci of disease, forming an accumulation of evils greater than that they were intended to avert.

Still, could it be shown that by such measures, the propagation and diffusion of disease from nation to nation can be averted, their adoption, under proper management, and with precautions for the personal safety and comfort of those concerned, would be justified as the minor evil. But, if it be true that the diffusion of epidemic disease is dependent in a great measure on atmospheric or general causes, then the futility of quarantine is obvious.

The British and Indian Governments, basing their measures for protection on ascertained facts, and not upon theories, have discontinued quarantine, whether by land or sea, relying upon sanitation and medical inspection, as the only and sufficient means of safety.

The British Government Local Board, recognising the contagious nature of some diseases and its probability in others, has adopted measures of inspection and isolation of the sick, together with disinfection, and purification of ships, effects and persons, insisting at the same time on all that conduces to the establishment of healthy conditions of living, but avoiding undue interference with personal liberty. The following is an epitome of their measures as regards cholera :—

Ships known or suspected to have cholera on board are to be detained by the Custom House Officers until the Medical Officer of Health shall have inspected them.

Those on board suffering from cholera are, if possible, to be moved to a hospital, but if they remain on board they are to be isolated, and all that comes from them disinfected.

Those not suffering from cholera, though coming from an affected ship, are to be allowed to proceed to their destination, notice being given to the Health Officer of the district to which they proceed.

The ship itself and the effects of any on board, who have suffered from cholera, are to be disinfected, and no further detention is to be imposed.

In India, quarantine, cordons and interference with personal liberty, including isolation of the sick, have been discarded as practically useless, attention being concen-

trated upon sanitary measures as the best means of preventing the diffusion of the disease.

The following is a summary of regulations for the army, which, as far as possible, are applied to the population generally.

In anticipation of an outbreak, personal cleanliness is enjoined, the utmost attention is to be given to the sanitary condition of the station; overcrowding is to be avoided and great care to be taken in watching and checking premonitary symptoms.

On the appearance of cholera, bodies of men are to be *at once removed from the affected locality;* great attention is to be paid to the purity of the water supply, and to the nature of the camping ground; all dejecta are to be buried in trenches dug for the purpose.

Purification and fumigation are to be resorted to, both of the room or building in which any case of cholera has occurred, and of the effects of the sufferers.

Temporary buildings are to be erected as hospitals, but, in the case of the general population, removal of the sick from their homes is not enforced. It is pointed out that no danger is incurred by attending on the sick.

Dr. Southwood Smith says, "the object of quarantine is to prevent the introduction of epidemic disease from one country into another," and the whole machinery of it is based on the assumption that by an absolute interdiction of communication with the sick, or infected articles, the introduction of epidemic diseases into a country can be prevented.

This assumption, however, overlooks the presence of an "epidemic atmosphere," without which it is now by many contended that no disease will spread epidemically. "Allowing therefore to contagion all the influence which anyone supposes it to possess, and to quarantine all the control which it claims," there remains this primary and essential condition which it cannot reach.

Experience shews that "the influence of an epidemic atmosphere may exist over thousands of square miles, and yet affect only particular localities." Why does it so localize itself? Probably because it finds there certain local or personal conditions, or both. It follows that we should make diligent search for all localizing circumstances and remove them, "so as to render the locality untenantable for the epidemic." Quarantine leaves all such conditions "untouched and unthought of."

The real question however is, can it prevent the extension of epidemic diseases, whether contagious or not? "If it can it is valuable beyond price; if it cannot, it is a barbarous encumbrance, interrupting commerce, obstructing international intercourse, perilling life and wasting public money." Whether it can do this or not is a mere question of evidence, and everything in India and Britain affirms that it cannot do so.

Professor Caldwell of America says: "Cholera, though a fatal scourge to the world, will, through the wise, beneficent dispensation under which we live, be productive of consequences favourable alike to science and humanity. Besides being instrumental in throwing much light on the practice of physic, it will prove highly influential in extinguishing the belief in pestilential contagion, and bringing into disrepute the quarantine establishments that have hitherto existed."

Measures of prevention and quarantine have been the subject of international conferences held at Constantinople in 1866, Vienna in 1874, and Rome in 1885.

The theories on which the measures recommended by these conferences are grounded have undergone little change since the conference at Constantinople in 1866; the basis on which all the conclusions with regard to preventive measures are built is still, as it was then, the theory of contagion.

Quarantine has, however, gradually been reduced from ten days imposed at the Constantinople conference, to seven days at Vienna, and to five days suggested in the unfinished conference at Rome; and even five days are not to be exacted unless the ship has had cholera on board, or has been gravely suspected, after leaving port. But great stress is still laid on quarantine in the Red Sea, as though that were the channel by which cholera entered Europe, of which there is really no evidence.

Great modifications were suggested at Rome with regard to pilgrim traffic to Mecca, ten days' detention in the Red Sea being reduced to five, and twenty-four hours only being imposed on ships with a clean bill of health.

Land quarantine was declared to be useless at the Vienna Conference, and both that and cordons were condemned at the Roman Conference on the ground that they were impracticable.

It will be observed, that though the theory of contagion

still prevails, it has undergone great modifications, suggesting the hope that the time may not be far distant when reliance will be placed upon sanitary measures which alone offer any guarantee for protection, rather than on such barbarous institutions as quarantine.

The question arises, what does it behove each individual of a community to do, as regards himself, his household, his village, town, and country, when cholera menaces, or has actually made its appearance?

Attention should be directed to careful living, careful clothing, and moderation in habits and diet. Avoid depressing influences, fear, over-fatigue, chills, violent alternations of temperature, aperient medicines, especially those of a saline nature, indigestible food, impure water, unripe or over-ripe fruit, and be careful to observe and promptly check any tendency to diarrhœa.

Pay attention to ventilation, to perfect drainage, to absolute purity of water supply, and to prevention of overcrowding, using all influence to secure this throughout village or town. Do not be afraid to attend upon the sick, for no danger is incurred thereby. Disinfect excreta, and thoroughly cleanse effects, houses and rooms.

Avoid quarantine and coercive measures which divert attention from the true sources of safety, summed up in the expression " complete sanitation."

Although much remains to be known about the causation of cholera and its apparent caprices in incidence and diffusion, yet from what experience and observation have taught us we seem to be warranted in stating the following to be facts with reference to the disease.

1. That cholera has been present in India and other countries from the earliest times, and that isolated cases occur in almost all countries.

2. That cholera is always present, not only in certain parts of India, but elsewhere, and that in India outside these areas its prevalence varies in different years and according to the season of the year.

3. That cholera does not attack all the places within an epidemic area.

4. Meteorological changes produce sudden alterations in the activity and intensity of an outbreak.

5. That the rate and direction of an epidemic are not influenced by facilities of communication or by the greatest streams of human traffic, the opening of the Red Sea route, *e.g.*, not having increased its diffusion.

6. That the cases are more frequent and more severe at the commencement, than in the continuance of an outbreak.

7. That hygienic measures afford the greatest security, but are not an all-powerful safeguard against cholera; local insanitary conditions and impure water favour its incidence and increase its intensity; that it is important to check all diarrhœa in times of cholera prevalence.

8. That cordons and quarantine have utterly failed to prevent the spread of cholera, but on the contrary, have done harm.

9. That to enter an area over which cholera is present, or to travel within that area, is especially dangerous to a new-comer, while residents whose circumstances of living are favourable, have a better chance of escape.

10. That removal is the best course when cholera attacks a regiment or other body of men.

11. That attendants on the sick have not suffered more than others.

12. That impure water, irritating articles of diet, unripe fruit, saline aperients are liable, during cholera prevalence, to bring on diarrhœa and the disease.

13. That fatigue, exhaustion, fear and anxiety are powerful predisposing causes.

14. Many circumstances attending the outbreak of the disease and the pathological conditions then developed, seem opposed to a specific poison as being the cause of the disease.

15. Having suffered from cholera gives no immunity from recurrence of the disease.

The sanitary measures recommended by Government, if carried out, are such as may imbue us with confidence, that if cholera appear, we shall be protected against any intensity of prevalence. The more we can perfect the measures now in force—and much can be done towards this, for insanitary houses are still far too numerous everywhere—the more thoroughly our individual and collective support, moral or material, be accorded, the more complete, we may anticipate, will be our immunity from the disease.

Experience in Europe during the recent epidemic, shows how futile coercive measures have been, while the examples of Marseilles, Toulon, Valencia, Palermo, Naples, whose notoriously insanitary conditions have paid their natural penalty, will be a salutary warning as to how cholera may

be intensified by local causes, and give a lesson which, it is to be hoped, will not be disregarded.

In the *Times* of Monday, February the 22nd, 1886, it was recorded that a memorial to the Lieutenant-Governor of Bengal, concerning sanitation, was laid before the Government of Bengal. This memorial states that since 1881, cholera has swept away more than 20,000 people in Calcutta and its suburbs; that in some suburban wards the death-rate has stood at 70 in the 1,000; that during the decade of 1875 to 1884, out of a population of 257,000 in the suburbs, no fewer than half had perished.

The laws of sanitary science are understood both here and in India, and the enactments of the Government would be effective if fully carried out, but no Government can force sanitation upon towns, villages, or houses, without the co-operation and support of the residents, and all measures will be found useless, unless backed by the personal efforts and exertions of individuals. Experience shows that in this country in the present day the best houses are often most defective, and that local causes of disease, which might be removed, abound, notwithstanding all that is done by the Government Local Board. In India, the reports of the Health Officer of Calcutta show that much is still wanted in that centre of cholera in the way of municipal aid, towards giving full effect to the sanitary measures necessary to control the disease. Let us hope that his advice will be attended to, for surely it would have the best results.

The cholera, which has been in Europe for the last five years, has now apparently died out, or at all events is dormant; but it may appear again, and wherever it can find a fitting nidus, *i.e.*, the presence of bad local conditions, all the quarantine and inspection in the world will not keep it out; that such bad local conditions in towns, streets, and houses exist, is proved by the reports of the Sanitary Associations, and of sanitary engineers who deal with these matters in localities where government officials can exercise no interference. The measures for their removal are simple enough if only the public can be brought to believe in the unseen but removable dangers which exist within, around and beneath their houses.

This is a great sanitary defect of the present day and cries loudly for reform; upon this it may depend whether pestilence shall find footing, or shall leave the locality unscathed.

But I must now bring these remarks to a close. Imperfect and incomplete as the account has been, I trust it may not have altogether failed in shewing how much epidemic cholera is under our own control. That, whatever may be its origin, its incidence, its prevalence and its dissemination are subject to physical laws which, if duly observed and enforced, will protect us from that which, if uncontrolled by the exercise of the sense God has given us, may prove like the destroying angel of the Apocalypse. Happily we have acquired some knowledge of these laws, and it depends on ourselves and how we apply it as to what the results may be. Epidemics are not a necessary, though a constant condition of man's existence on earth. They are amenable to the laws of hygiene and of common sense. "Let us," says Dr. Dallinger in a recent address, respecting small-pox, "do our duty and act up to our knowledge, and as surely as disease comes among a people by physical laws broken, so it will depart from them if they see to it that physical laws are obeyed."